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Journal

OF THE

Royal Army Medical Corps

EDITED BY

COLONEL W. H. HORROCKS, K.H.S.

ISSUED MONTHLY

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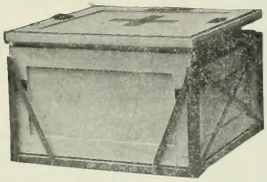

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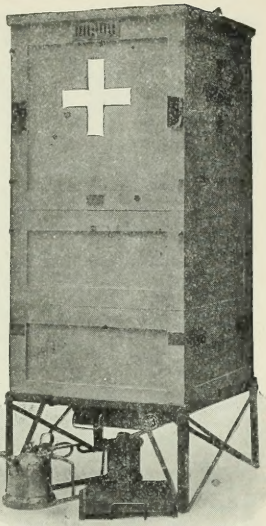

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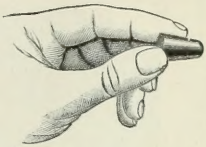

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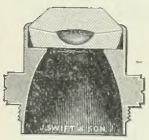

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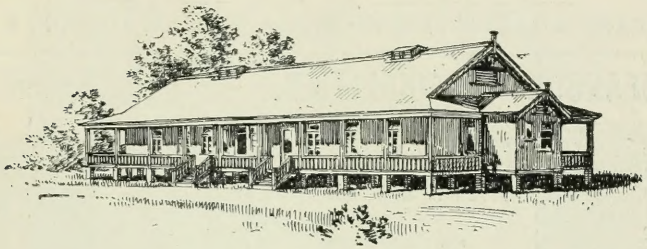

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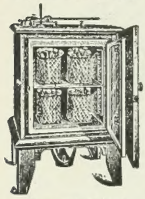

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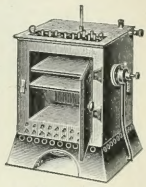

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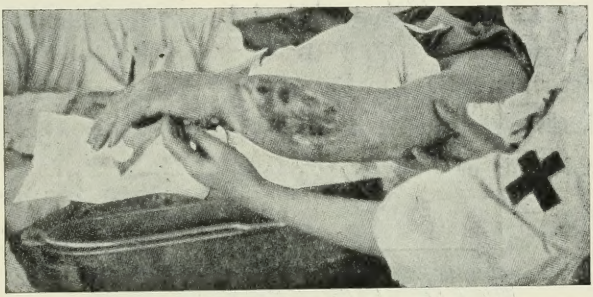

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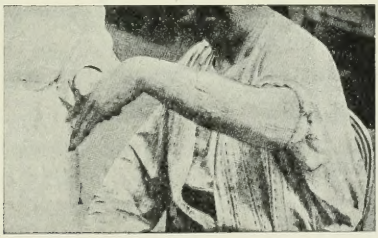

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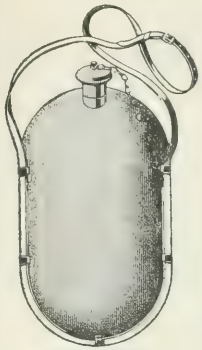

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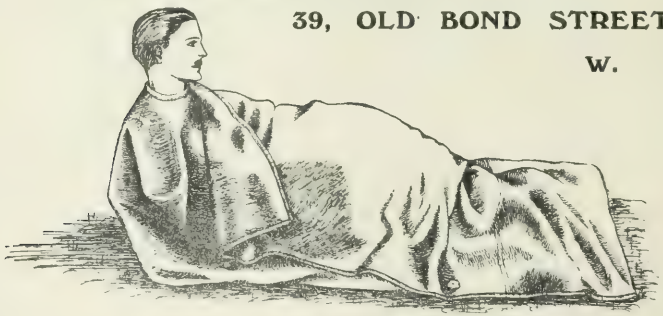

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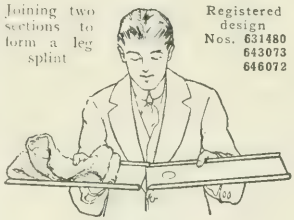

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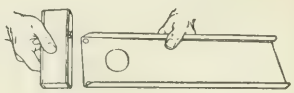

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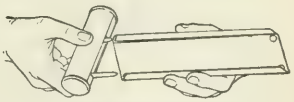
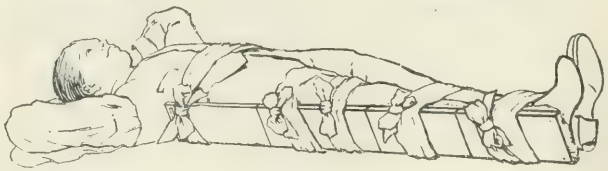


Joining wrist attachment to section



Several sections joined to form thigh splint

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To face first matter

VOLUME XXVI. SEPTEMBER, 1915. No. 3.

Journal

of the

Royal Army Medical Corps.

Original Communications.

REPORT ON THE RESULTS OF THE BILHARZIA MISSION IN EGYPT, 1915.

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(*Continued from p.* 181.)

PART III.—DEVELOPMENT.

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DEVELOPMENT IN INTERMEDIARY.

HETEROGONY.

THE reproduction of digenetic trematodes takes the form known as heterogenesis or heterogony, of which the chief features are : (*a*) an alternation in the modes of reproduction, an asexual phase alternating with a sexual phase; (*b*) the asexual individuals differ in shape and in

internal structure from the sexual forms; (*c*) the two kinds of reproducing individuals live under conditions which are more or less radically different. All digenetic trematodes have their asexual phase in the mollusca, and for the most part in the gastropoda. The sexual phase is attained in a vertebrate. The asexual phase has one or more generations. The egg on hatching gives rise to a ciliated larva, the "miracidium," which dies in about twenty-four hours unless it has been able to harbour in a suitable mollusc. Within this mollusc the miracidium, usually after migrating to the digestive gland or "liver," becomes changed into a smooth-walled sac called a sporocyst. Budding from the wall of the sporocyst results in bodies which may be of three kinds: (*a*) cercariæ; (*b*) daughter-sporocysts; (*c*) rediæ. The cercariæ are typically immature adults provided with certain larval structures to enable them the better to invade the definitive host. They are the infective forms.

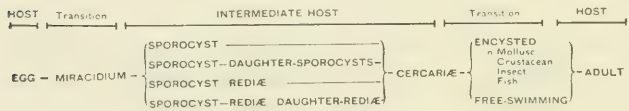

FIG. 40. Life-cycle of a digenetic trematode.

The daughter-sporocysts are elongated sacs resembling the mother-cysts, and are not provided with alimentary canal or suckers. They migrate from the mother-cyst to other parts of the digestive gland, and later give rise by budding to cercariæ.

Rediæ are characterized by the presence of a single sucker and a simple sac-like alimentary canal. These give rise by internal budding (*a*) to cercariæ, or (*b*) to other rediæ which ultimately give a brood of cercariæ.

These four lines of development which may be taken by a degenetic trematode are graphically tabulated in fig. 40.

From the account already given of the experimental production of adult Bilharzia worms after submission of a suitable definitive host to infection by cercariæ, it was evident that bilharzia development probably followed one or other of these alternative courses. In fact, the Bilharzia worms are typical digenetic trematodes, and conform to the second type of development in the intermediary host.

The Bilharzia miracidium gives rise to a sporocyst, which in turn produces daughter-sporocysts (fig. 41).

After leaving the mother-cyst, the daughter-sporocysts migrate into the tissue of the digestive gland and grow rapidly. They become greatly elongated and eventually ramify throughout the organ, so increasing its bulk that an infected Planorbis can be

Fig. 41.—A sporocyst from Planorbis containing daughter-sporocysts. On the right is a free daughter-sporocyst.

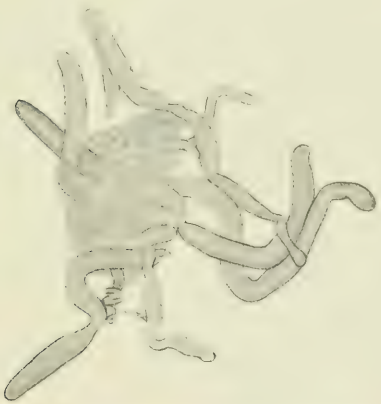

Fig. 42.—Daughter-sporocysts teased from Planorbis.

detected at a glance. The colour also of the organ is changed. In *Planorbis boissyi* the digestive gland is dark brown or black, but when infected this changes to ochre.

The ends of the daughter-sporocysts are solid, but the walls of the tubular bodies are very delicate and transparent, so delicate that it is impossible to dissect a complete sporocyst free from the tissues. As the cercariæ develop within them, the sporocysts may

become markedly constricted by the host tissue (fig. 44), and a certain amount of multiplication may possibly occur through cission. These sporocysts appear to absorb their nutriment through their walls, as they have neither oral sucker nor alimentary canal. The glandular tissue of an infected organ disappears apparently through pressure atrophy (fig. 44). The sporocysts are capable of travelling by wriggling movements. The cercariæ leave the sporocysts through

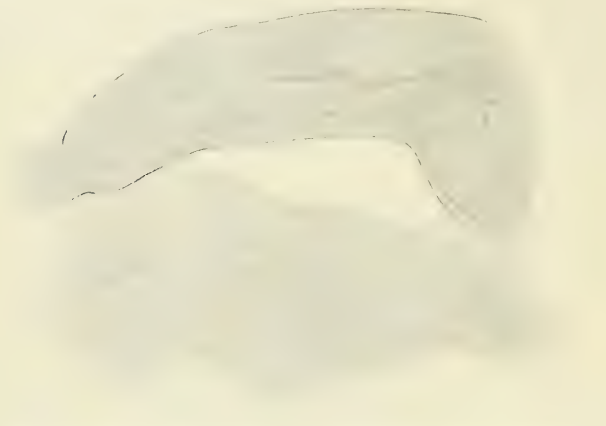

FIG. 43.—Terminal portion of a daughter-sporocyst containing fully developed cercariæ.

simple rupture of the over-distended wall. They are discharged from the mollusc in "puffs," a number being periodically shot into the water. This discharge occurs quite independently of the passage of fæces by the snail.

In Bilharzia as in all digenetic trematodes the terminal phase of development in the intermediate host is the cercaria, and this alone is the infective stage.

Differentiation of Cercariæ.

A cercaria consists typically of two parts, viz., body and tail. The tail is always discarded when the body enters its final or definitive host. It is therefore a purely larval structure. The body, on the other hand, is actually the undeveloped adult, many of

the adult characters being almost undifferentiated. In addition to these the cercarial body may have other structures which have been serviceable during its growth in the molluscan host, but which are absorbed and entirely disappear after the final host has been reached. There are, then, in every cercaria "adult" characters and "larval" characters, the former being chiefly exhibited by the digestive, excretory and genital systems and by the oral and ventral

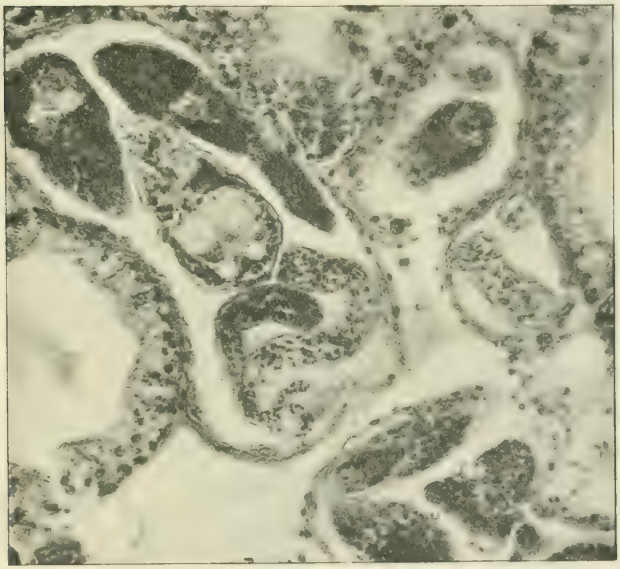

FIG. 44. Section of digestive gland of infected *Planorbis boissyi*, showing extent of atrophy of tissue.

suckers, the latter by the tail and by the armature of the skin, the mouth, and body. By utilizing the "adult" characters, especially those exhibited by the oral and ventral suckers, the cercariæ may be placed in one or other of the four great groups into which the adult digenetic trematodes are subdivided, namely, Gasterostomidæ, Monostomidæ, Amphistomidæ and Distomidæ. (With the exception

of a small group in which the body shows practically no internal differentiation and to which the special name "lophocerca" has been given.) For the purposes of differential diagnosis the cercariæ, being all at the same stage in development, may be regarded tentatively as a separate group of animals, and their differentiation based upon their most striking characters, whether they be "adult" or "larval." The classification of the cercariæ proposed by Lühe in 1909 resolves the distome cercariæ into easily recognizable subdivisions with a corresponding descriptive terminology derived partly from the generic nomenclature proposed by Diesing in 1858. These subdivisions are based upon the character of the tail.

LÜHE'S CLASSIFICATION.

A. Gasterostome cercariæ.	Mouth opening in the middle of the ventral surface. Intestine simple sac-shaped. Two long projections from the end of the body.
B. Monostome cercariæ.	Ventral sucker lacking.
C. Amphistome cercariæ.	Ventral sucker at the posterior end of the body.
D. Lophocercariæ.	Cercariæ with longitudinal cuticular projections along the sides of the body.
E. Distome cercariæ.	Ventral sucker towards middle of body.
(1) Cystocercous cercariæ	Base of the tail forms a space into which the body can be drawn.
(2) Rhopalocercous cercariæ.	Tail having as great or greater width than the body.
(3) Leptocercous cercariæ.	Tail straight, slender, and narrower than the body.
(a) Gymnocephalous cercariæ.	Anterior end rounded, without stylet or boring spine.
(b) Echinostome cercariæ.	Anterior end with a collar and crown of thorns.
(c) Xiphidiocercariæ.	Anterior end with stylet.
(4) Trichocercous cercariæ.	Tail set with spines.
(5) Cercariæ.	Tail entirely undeveloped.
(6) Rattenkonigcercariæ.	Cercariæ with tails joined, forming a sort of colony.
(7) Microcercous cercariæ.	Tail stumpy.
(8) Furcocercous cercariæ.	Tail forked at its end.

Description of Bilharzia Cercaria.

The various trematode larvæ found in each genus of fresh-water molluscs in Egypt are tabulated according to this classification and are described in a succeeding part. Their chief interest in relation to the present inquiry lies in their similarity to the Bilharzia cercaria.

When bilharzial cercariæ are seen floating in water the most

noticeable character is the presence of a Y-shaped tail. This character is common to the group lophocerca and to the furcocercous division of the distomes. In the former group the ventral sucker is absent, in the latter it is well developed. It is to this

Fig. 45. Fig. 46. Fig. 47.

Figs. 45, 46, 47.—Various Bilharzia cercariæ found in molluscs around Cairo.

latter group that the Bilharzia cercariæ belong. The following furcocercous cercariæ were found: *C. vivax* in Cleopatra; C. *fissicauda* in Bullinus; a form very similar to *C. ocellata* in Melania, *Planorbis boissyi* and *P. mareoticus*, which we provisionally named "*C. bilharziella*"; and the cercariæ of bilharzia in Bullinus and in

P. boissyi. *C. vivax* and *C. fissicauda* both possess a muscular pharynx behind the oral sucker, in the other forms this is absent. "*C. bilharzia*" and "*C. bilharziella*" are related and probably belong to closely allied genera in the family Bilharzidæ. "*C. bilharziella*" possesses a pair of pigment spots anterior to the ventral sucker and there is a cuticular keel along each side of the prongs of the tail. These are absent in the Bilharzia cercariæ.

The relation or identity of the Bilharzia cercariæ found in the molluscs Bullinus and Planorbis will be discussed in the articles dealing with the adult worms.

Skin Infection.

Experimental evidence has already been given (p. 44) in favour of the direct penetration of the skin and of the mucous membrane of the mouth and gullet by the Bilharzia cercaria. Many writers appear to have the greatest reluctance in accepting the possibility of skin penetration. Some, like Allan, believe that infection is limited to the tender skin of the prepuce and advocate universal circumcision; Ruffer and others interpret infection during immersion in Bilharzia-infested countries as due to entrance of the cercaria through the anus.

In the *United States Naval Medical Bulletin* for October, 1915 (p. 648), Post writes that our experimental infection of rats by immersion "clearly shows, it seems to me, that the most usual port of entry must be the anus."

It may be pointed out, however, that: (*a*) Certain cercariæ are known to penetrate the tissues of the second intermediary host to encyst, and are provided with special glands and, in some cases, stylets to enable them to do this. (*b*) If a young rat or mouse be suspended in a large test-tube containing water full of Bilharzia cercariæ, these cercariæ can be seen to approach and fasten on to the limbs and body of the animal. When the animal is removed half an hour later, there remain in the fluid only a few cercariæ and a large number of *detached* tails. (*c*) A young mouse so immersed for half an hour was killed, and subsequently embedded whole in paraffin. Sections of the body and of the limbs showed the cercariæ at all stages of entry. They were found in the act of passing through the unbroken skin, and not through the pores or hair-follicles (*vide* figs 49 to 55).

The cercariæ seemed to be attracted by the warmth of the body, as similar evidence was rare in a recently dead mouse similarly immersed and the degree of penetration slight.

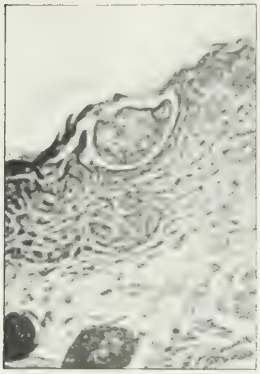

FIG. 48.

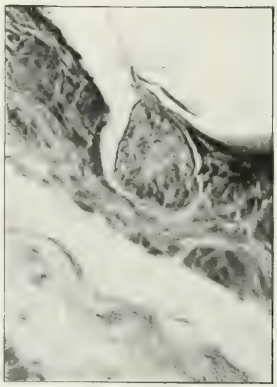

FIG. 49.

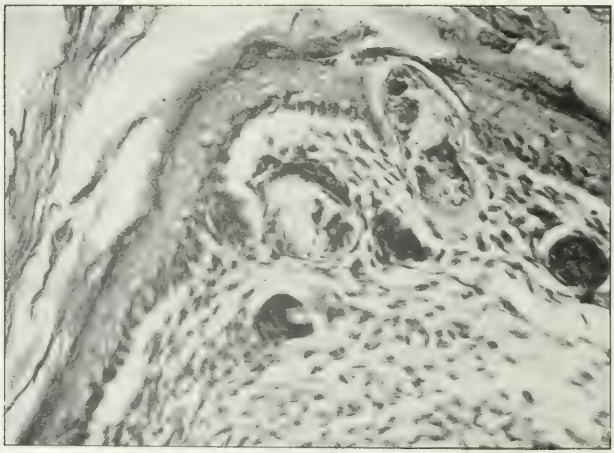

FIG. 50.

Figs. 48, 49, 50.—Micrograms of sections of skin of a newly born mouse which had been immersed for half an hour in water containing large numbers of Bilharzia cercariæ.

To illustrate "Report on the Results of the Bilharzia Mission in Egypt, 1915," by Temporary Lieutenant-Colonel ROBERT T. LEIPER, D.Sc., M.B., R.A.M.C.

FIG. 51

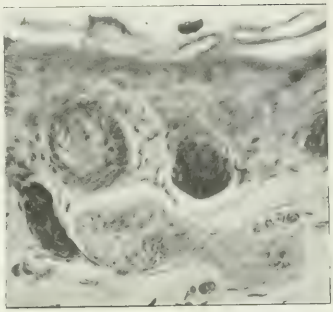

FIG. 52.

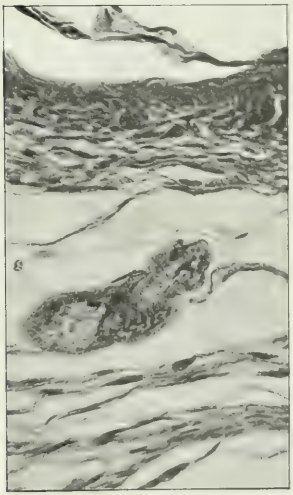

FIG. 53.

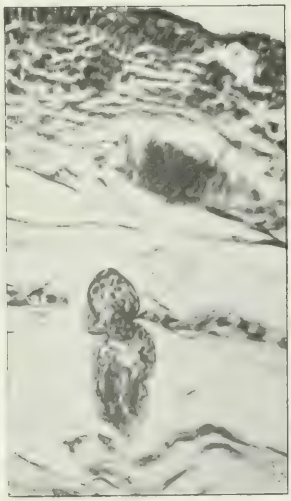

FIG. 54.

Figs. 51-54.—Sections of skin of a newly born mouse which had been immersed for half an hour in water containing large numbers of Bilharzia cercariæ.

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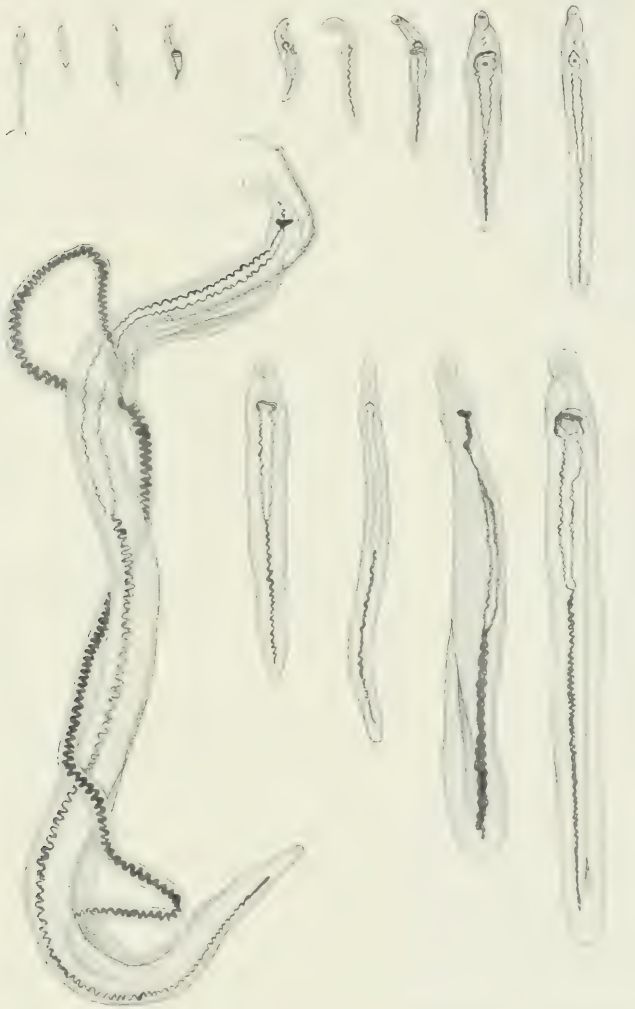

FIG. 55.—Bilharzia worms at various stages of development obtained from the liver of a rat and of a guinea-pig experimentally infected two months previously.

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Development in the Definitive Host.

Once the cercaria has entered the definitive host it undergoes no further metamorphosis. There is gradual growth with differentiation of organs, and in Bilharzia with differentiation also of male and female individuals. The males are early recognizable from the females by their greater breadth and the stouter formation of the ventral sucker. In the accompanying plate is figured, under the same magnification, at the various stages, the gradual development of the adult body in all its phases from the cercaria before it enters to the paired egg-producing adults two months later. The route taken by the cercarial body in its transit from the skin to the portal system is still under investigation. It is noteworthy here, however, that the cercariæ do not all appear to arrive in the liver at the same time. Some of the smallest forms were obtained by teasing liver which contained also forms almost fully grown. This accords with Professor Looss's experience in ankylostome infection. A number of larvæ probably become "lost" in the tissues. It may be, however, that a certain number enter the blood-stream direct, while others pass first through the lymphatic system.

(To be continued.)

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(*Conclusion of Bibliography.*)

BERIBERI IN LEBONG.

An Account of the Steps taken to Eradicate the Disease during 1914.

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In the year 1911 an epidemic broke out amongst the men of the 3rd Middlesex Regiment stationed at Lebong which presented the symptoms of multiple peripheral neuritis. The disease continued to make its appearance in 1912 and 1913, occasioning much concern, and was the subject of investigation by the sanitary officer of the Division and of reports from the medical officers of the station.

These officers all agreed in being unable to assign any definite cause for the disease, and were able to eliminate such causal agents as alcohol or arsenic.

No record of a similar disease having occurred at Lebong prior to 1911 could be found, and the fact that the regiment affected in that year had come from Singapore in the previous cold weather gave rise to the theory that the disease had been imported and was of an infectious or contagious nature.

In November, 1912, The King's Own Regiment relieved the Middlesex at Lebong. In June, 1913, the disease broke out again, and by the end of November sixty-five cases had occurred.

In consequence, the D.M.S., India, appointed a Committee to investigate the nature and cause of the disease and to report by what means it could be prevented. This Committee, consisting of Major E. D. W. Grieg, I.M.S. (President), Major F. Harvey, R.A.M.C., Captain G. I. Davys, I.M.S., and myself, met towards the end of December, 1913. We were handicapped in our investigations by the fact that the regiment had left Lebong for the Dacca manœuvres, leaving behind only a detachment which consisted chiefly of convalescents and men attending hospital for slight symptoms of the disease. Futhermore, none of the cases in hospital were of recent origin, thus precluding any satisfactory bacteriological or clinical research work. There seemed to be no doubt, however, that the disease was beriberi.

In view, therefore, of the large and ever-accumulating amount of recent research work which points to this disease being due to a deficiency in an element of diet, vitamine, which is essential

for the proper nourishment of nerve tissue, we directed our attention mainly to the investigation of the dietary of the regiment. At the same time we endeavoured to keep before us the rival theory of those who believe that the disease is a specific infection.

It is not within the scope of this paper to relate the details of our investigations; suffice it to say that in a very short time even those of us who were the most sceptical of the vitamine theory had begun to look upon the food of the troops with the gravest suspicion.

Put very briefly, the conclusions of the Committee were:—

(1) That the disease was beriberi;

(2) That as regards the available clinical material there was no evidence of a bacterial or protozoal causal agent;

(3) That the food of the troops could only be described as dangerously lacking in vitamine content;

and they recommended—

(1) That a fixed dietary be laid down;

(2) That the cooking be specially supervised;

(3) That an officer be appointed for a year to supervise the whole rationing of the troops, including quality of food, preparation, cooking, serving and all details;

(4) That the troops be regularly weighed and records kept.

The immediate result was that I was ordered to proceed to Lebong at the end of February to do what was possible to carry out the recommendations of the Committee. My duties began on March 1 and finished at the end of October on the departure of the regiment for England.

My official report was submitted in due course, and this paper is the result of a request for its publication. The report is a lengthy one, and I have been requested to present it in an abridged form suitable for publication.

The points that engaged my attention during the year were many, and it is necessary, in order to give a lucid account, to place my observations and record my facts under separate headings.

Table No. I gives the monthly incidence during 1914 compared with previous years and does not include readmissions or relapses.

During 1913, 65 men of the King's Own contracted the disease at Lebong, and 9 at Barrackpore, making a total of 74. Of this number 38 continued to require treatment during the early part of 1914 or relapsed during the year. All these men, with the exception of one who died, were fit when the regiment left Lebong on October 26.

The Incidence of Beriberi in 1914.

Table I.

	1911	1912	1913	1914
January	—	—	—	—
February	—	2	—	—
March	—	2	—	—
April	—	—	—	—
May	—	1	—	—
June	—	—	2	1
July	2	2	5	1
August	5	7	15	1
September	3	3	25	1
October	21	7	12	—
November	15	2	6	—
December	—	—	—	—
	—	—	—	—
	46	26	65	4

Of the 4 cases contracted in 1914, 1 died, 2 were able to proceed home with the regiment, and the fourth was able to join the regiment before it sailed from Bombay. This is a very great contrast to the state of health obtaining in the regiment at the end of 1913.

Table II.

Incidence by Companies	A	B	C	D	E	F	G	H		
1913 ..	1	3	12	12	10	18	2	7	=	65
1914 ..	3	—	—	—	—	—	1	—	=	4

Table III.

Incidence by Bungalow No.	1	2	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1913 ..	—	2	1	—	—	—	2	1	2	2	5	9	—	5	7	6	12	6	4
									and 1 in hospital										
1914 ..	—	—	1	—	—	—	—	—	—	—	—	—	—	—	--	2	—	—	1

Referring to Tables II and III, I would draw attention to the point that 3 of the 4 cases in 1914 came from "A" Company, occupying bungalows 18 and 21. These bungalows, along with 19 and 20, are situated at the lowest and remotest part of the cantonment (*vide* plan) and in 1913 provided 28 out of 65 cases and, with bungalows 16 and 17, which are just as badly situated, 40 cases. Later, I venture to suggest an explanation of this fact.

It is of importance to study the history of each case, and I give the particulars in full.

Case 1.—Private P., aged 24, one year and three-quarters in India, "G" Company, admitted June 22 from dormitory 2, bungalow 5, which he had occupied for the last six months. In 1913 there was 1 case in the same bungalow but none in his dormitory. There were 9 "contacts" (men occupying the same dormitory). None of

these "contacts" had had beriberi and none showed signs of the disease, but 5 of them had lost five pounds weight or more up to June 13. During the period April 25 to June 13 it had been noted that 13 men of "G" Company had lost five pounds or more in weight and 6 of them (including Private P.) lived in this dormitory. It was found that 3 had suffered or were still suffering from gastric trouble and diarrhœa, the other 2 seemed quite fit but complained of their food—that they could not eat the meat and did not get enough variety. These "contacts" were kept under observation and remained fit, though 1 required treatment for indigestion and loss of appetite.

Personal Particulars. — Not a beer-drinker, a very moderate smoker, not an athlete, but was not in the habit of sleeping in the afternoons; lost five pounds weight in a month.

Previous History.—In hospital from March 16 to April 20 with sprained ankle and eczema. Ever since his discharge from hospital he had not felt fit and lost his appetite. In the beginning of June he had diarrhœa for about ten days, and while on company training got very wet three days in succession. From this time he began to suffer from pains in his legs and felt breathless. On June 10 he began physical training and after a day or two his legs got swollen, painful and weak, and on the day of his admission to hospital he could barely walk.

Progress of Case.—This was a mild case and did not develop acute symptoms. He had loss of knee-jerks, weakness of leg muscles but no actual paralysis, patches of anæsthesia, and, later on, some cardiac dilatation.

Case 2.—Private B., aged 24, two and three-quarter years in India, "A" Company, admitted July 21 from dormitory 4, bungalow 18, which he had occupied for the last six months. In 1913 there were 6 cases in the same bungalow and 3 in the same dormitory. There were 15 "contacts." One had had beriberi in 1913 but was a mild case and had been doing full duty since March 16. Two had been admitted to hospital some weeks previously with swollen legs, due in one case to valvular disease of the heart, and in the other to severe eczema with debility and disordered action of the heart.

Personal Particulars.—Not a beer-drinker, a moderate smoker, athletic; lost five pounds weight.

Previous History.—He suffered from malaria at Barrackpore in 1913. His first symptoms appeared on July 5, when he reported sick with diarrhœa and vomiting and attended hospital for treatment till July 20, when he was admitted to hospital. Under

treatment the vomiting stopped at once and the diarrhœa in a few days, but he continued to be debilitated, and when allowed up developed disordered action of the heart. About August 10 he complained of pains and stiffness in his legs, and the knee-jerks were found to be absent.

Progress of Case.—Acute symptoms of the disease very rapidly appeared in spite of all treatment and culminated in acute dilatation of the heart. He died on September 19.

Case 3.—Private D., aged 22, three years in India, "A" Company, admitted September 5 from dormitory 3, bungalow 21, which he had occupied for the last six months. In 1913 there were four cases in the same bungalow and one in the same dormitory.

There were ten "contacts." None of them had had beriberi and all were fit.

Personal Particulars.—Not a beer-drinker, a non-smoker, not athletic, but not indolent in habits; lost eighteen pounds in weight.

Previous History.—In hospital for malaria, April 21 to May 4, and June 20 to June 30. After discharge from hospital he attended for quinine and then joined his company at physical training during the latter three weeks of July. He states that he found the course rather a strain and had to fall out on occasions. On July 29 he began company training, and after doing about two weeks of this he got diarrhœa and began to feel seedy. He got worse, feeling faint and giddy and vomiting at times, and reported sick. He attended hospital, but as he did not improve was admitted on September 5.

Progress of Case.—The vomiting was very persistent about the time of his admission and was not controlled for some days. Slight symptoms of the disease developed, affecting the legs chiefly and to a lesser degree the heart. He made a good recovery.

Case 4.—Private A., aged 26, three and a half years in India, "A" Company, admitted September 27 from dormitory 2, bungalow 18, in which he had lived for the last six months. One case occurred in this dormitory in 1913.

There were eight "contacts." None had beriberi and all were fit.

Personal Particulars.—Not a beer-drinker, a moderate smoker, not an athlete and occasionally indolent, well developed physically, and had lost sixteen pounds weight.

Previous History.—Had pneumonia at Dacca in December, 1913. About the end of August, while on company training he began to feel ill. He lost his appetite, sometimes vomited, suffered from cough at night, and complained of tightness in his chest. He

reported sick and was admitted to hospital and diagnosed bronchial catarrh. After his discharge on September 16 he felt all right for two or three days, but as soon as he attempted full duty his legs began to get painful and swollen. On his admission to hospital on September 27 his legs were œdematous and there were patches of anæsthesia, and the knee-jerks were absent.

Progress of Case.—The case did not develop further, and made a rapid recovery.

The Dietary.

In view of the findings of the Beriberi Committee, my duty was obviously to see what could be done by thorough supervision of the dietary of the regiment.

The British soldier in India receives from Government a ration consisting of meat, bread and potatoes one pound of each, rice and flour two ounces of each, and some sugar and tea. As a rule only three-quarters of a pound of potatoes is drawn from the commissariat and for the other quarter a quantity of mixed vegetables of the same value, and consequently varying in amount according to the market prices. This item is of importance and should always receive careful attention. He also receives a messing allowance of two and a quarter annas a day, and in addition it may be reckoned that he gets a grant of at least one pice a day from the president of the regimental institutes.

The messing is run generally on the company system and can be done well and economically in the Plains.

In the hills, however, and particularly at Lebong, the messing cannot be run either so economically or so efficiently, because the rations are not as a rule so good, and the extras which are required to supplement the rations are more difficult to obtain and much more expensive.

For instance, the meat ration at Lebong is distinctly poor. The cattle (which the Indian does not breed for food) have to be driven some hundred miles from the Plains to the foot of the Hills and then a further forty miles into the Hills. When slaughtered they are, as a rule, in miserable condition, although they are allowed a rest of a fortnight at the foot of the Hills and are not supposed to be killed for some days after arriving at Darjeeling. They are not grain-fed and the pasturage is poor. The meat is deficient in fat, tough, and has an excess of bone. There is no doubt that the vitamine value of such meat must be low.

Again, such supplementary articles of food as fresh milk and

eggs, important for their vitamine value, were almost entirely lacking in the men's dietary. Fresh milk, on account of the difficulty of obtaining it in sufficient quantity and its expense, was replaced by tinned milk, an article of no vitamine value. Eggs were bad, unless a price was paid that was prohibitive for the men.

Furthermore, an examination of the messing books revealed the fact that the men's taste did not lie in the direction of such articles as oatmeal, peas, lentils, or barley—all valuable supplementary foods, especially where the meat ration is of poor quality.

Lastly, there was an undoubted tendency to monotony in the diet. This fact and the poor quality of the meat had a depressing effect on the appetite.

During 1914 there was a distinct improvement in the quality of the rations supplied to the troops, but the raising of the standard of the messing to that desired by the Beriberi Committee was a matter of considerable difficulty.

It was obvious from the first that it would be quite impossible to raise the standard of the messing without increasing the expenditure. The messing money was quite inadequate. With the aid of the master cook I drew out a specimen diet on the lines of that laid down by the Beriberi Committee, economizing where possible, and making alterations to suit the taste of the men. It was found that such a diet would cost at least four annas per man per day. The commanding officer went into the matter very carefully, and, at a meeting representative of the regiment, it was decided to raise the messing contribution for each man to four annas per day. This, along with a grant from the president of the regimental institutes, brought the sum available for messing to four and a quarter annas per man per day. By means of lectures, commanding officer's orders, and personal supervision, the company messing committees were instructed how to draw up their weekly diet sheets, which had to be approved by the commanding officer. At the end of each week the actual daily menu of each company was submitted to me, and I drew the attention of the commanding officer to any deficiencies or suggested further improvements.

The attention of the messing committees was directed to the following points: Fresh milk to be used instead of tinned. A different dinner to be given each day. Full use to be made of bones for stock, and soups to be given as often as possible. Sweet puddings three or four times a week. Full use to be made of the

flour ration in making dumplings and pies. (A large proportion of the rice and flour ration used to be sold.) As much use as possible to be made of the following articles: eggs, moong dhal, oatmeal. Extras to be provided for tea; advantage to be taken of the heart, liver, tails, brains, &c., of ration animals. The tea hour was changed from 4.30 to 6 o'clock, and a substantial meal provided. Formerly nothing was provided beyond tea and dry bread between midday dinner one day and breakfast the next day. "Chota hazri" was also insisted on before early morning parade.

The cooking was very carefully supervised, and every endeavour was made to make the meals appetising. Owing to the inferiority of the rations, it was found that a very large proportion of the meat was thrown away unless it was served up in some form of mince.

The new dietary was, on the whole, appreciated by the men, but, of course, there was grumbling at the extra expense. Under the old system many men, probably the majority, bought suppers for themselves at night, but the new scheme relieved them of this, and at the same time assured that *every* man had a substantial meal in the evening. In this connection an important point should be noted, viz., the peculiar conformation of the cantonment and the relation of the various bungalows to the coffee-shop. The lowest bungalows (*vide* plan) are a considerable distance from the coffee-shop, and not many men would take the trouble to climb three hundred feet to buy their suppers, especially if at the same time they ran the risk of being soaked to the skin. This difficulty had been recognized by the regimental authorities, and the men had been permitted to cook their suppers in their own rooms. The objections to such a practice will be evident.

In September the Government of India sanctioned the issue to the British troops in Lebong of the extra articles of diet recommended by the Beriberi Committee and ordered the scales and issues to be fixed by the local medical authorities. Thereupon a requisition was made for the supply of the following articles:—

Moong dhal to be issued four times a week; dripping or suet, daily; cocoa, twice a week; jam, twice a week; oatmeal, twice a week; split peas, once a week; barley, once a week; blue peas, once a week; mutton, twice instead of once a week; whole-meal bread, twice a week as an experiment; vegetables, a fixed ration of 7 oz. in addition to 12 oz. of potatoes; meat, 20 oz. ration (as ration meat contains about 30 per cent bone).

This order came too late to benefit The King's Own Regiment, but it is hoped that the arrangements will be completed for the troops this year.

I should at this point like to say how much I appreciated the hearty co-operation of the regiment, from the colonel downwards, in carrying out the work, which entailed on them no little pecuniary sacrifice.

Appended are two actual weeks' diet sheets as samples of the messing during 1913 and 1914 respectively :—

"E" Company, from July 1 to July 7, 1913.

Breakfast	Cheese & onion	Meat & salad	Bacon & tomatoes	Steak & onions	Bacon & onions	Butter	Cheese & onions
Soup ..	..	..	..	..	..	..	..
Meat ..	Roast	Stew	Roast	Roast	Stew	Roast	Stew
Pudding ..	..	..	..	..	..	Stewed peaches	..
Tea ..	Tea and bread ; no extras.						

"A" Company, from August 2 to August 8, 1914.

Breakfast	Cold pork & sauce	Porridge & butter	Steak & onions	Bacon & onions	Eggs & butter	Porridge & cutlet	Butter
Soup ..	..	Dhal	..	Dhal	..	Barley	..
Meat ..	Roast	Hotpot	Brown stew	Roast	Irish stew	Potato pie	Irish stew
Pudding ..	Currant	..	Rice	..	Treacle	..	..
Tea	Potato cutlets	Eggs & butter	Sausage tomato	Cold meat & salad	Potato pie	Butter	Meat rissoles.

Accommodation and Hygienic Conditions.

The accompanying plan of the Lebong Cantonment shows the disposition of the bungalows and their heights above sea-level. Bungalows 11, 12 and 13 are situated on the ridge of the spur of Lebong, the others lie on the slope on either side. Owing to the steepness of the mountain side these latter have been built parallel instead of at right angles to the side of the mountain, consequently they are all more or less overhung. This fact interferes with efficient ventilation and in the rainy season renders them very damp. The bungalows on the western slope suffer most from this disability and are also more exposed to the prevailing damp winds. The dampness of these bungalows was clearly demonstrated when

I took up the flooring of one of the rooms (4 Bungalow 20). The majority of the men in this room were suffering from some ailment such as sore throat or diarrhœa and complained of a smell. The earth underneath the flooring was damp and mouldy, and the musty odour was simply overpowering. The investigation resulted in my contracting a severe sore throat.

To put it mildly, there is no doubt that such a condition must have a depressing effect on the health of the men, and it has been strongly recommended that the bungalows should have a concrete basement and thorough ventilation between the basement and the flooring. It is interesting to note that two of the bungalows (Nos. 6 and 7) already have concrete basements and that no case of beri-beri occurred in either of them in 1913.

Rough plan of Lebong Cantonment, showing the altitude of each bungalow, thus $\frac{5950}{}$, in feet above sea-level.

Distances: From Bungalow 20 to the coffee-shop is about 730 yards by a steep winding path. From the coffee-shop to the Parade Ground is 660 yards.

I have already referred to the fact that the six bungalows Nos. 16 to 21 with a nominal accommodation of 338 out of a total of 890 provided 30 out of 60 cases in 1913, and 3 out of 4 in 1914. I am inclined to believe that a partial explanation may be found in the great distance between these bungalows and the parade ground and the difference in altitude. A man living in No. 20 has to go three-quarters of a mile (reckoned on the level) and climb a height of 425 feet. He probably does this before breakfast, and at least once between breakfast and dinner. Then again, the canteen and coffee-shop are 730 yards distant and 375 feet higher up. I feel sure that these facts should be borne in mind

when regulating the training of the men, especially when we consider the altitude and the effect of the climate on the general health.

The accommodation was found to be deficient. By reason of the bungalows being only 20 feet broad instead of 22 feet, each man had 6 square feet of floor space or 60 cubic feet less than the regulation. As soon as this was appreciated the number of men in each room was readjusted and it was found necessary to send about 100 surplus men to Barrackpore.

Throughout the year two rooms were set apart for the segregation of those men still attending hospital for beriberi contracted in 1913, and four rooms were kept vacant for the reception of "contacts" of fresh cases. As soon as a fresh case occurred the room was vacated and disinfected and the "contacts" were sent to a vacant room and kept under observation.

Loss of Weight.

As I have already pointed out, all the 1914 cases of beriberi suffered considerable loss of weight. Loss of weight is an important prodromal of beriberi, therefore the regular weighing of the troops should be of great assistance in the early detection of the disease.

In spite of the improvement in the dietary of the regiment there was a general loss of weight during the year, and for this I have endeavoured to find some reason. To this end the weighings were taken as far as possible at the beginning and end of the different courses of training.

The accompanying chart shows the average loss or gain in pounds per man of six companies for six months. Only the men who have been weighed regularly are included in the calculation. Those who were absent from one of the weighings, attending hospital or for other reasons, have been excluded. Therefore we are dealing with the more healthy portion of each company. The total loss or gain at each weighing has been divided by the number of men weighed. The normal line is fixed by the first weighing, and along this line is shown the period during which the company was engaged in Physical Training and Gymnasium (P. T.), Company and Field Training (C. T.), and Musketry (M.). During the rest of the period the companies were doing ordinary duty, guards, parades, physical exercises two mornings a week and a weekly route march.

At the foot of the chart is the curve of the rainfall of Lebong during 1914. For the uncharted portion of the year the rainfall

is negligible, and during the month of October the weather was delightful.

The principal feature of the curves of weight is the very definite fall in July and August, and in every case the September weight is the lowest. I have not the least hesitation in attributing this to the climate, in other words to the rainfall. Conclusive evidence is afforded by the universal increase of weight in October, and by the great improvement in general health and appearance of the men during that month. I have no doubt that had it been possible to continue the observations the curves would have regained the normal line during the next few months.

It will be noticed that "E" Company's curve differs from the rest in showing a rise to the end of June. This may be explained by the fact that this company returned to Lebong on relief from Barrackpore towards the end of May. A number of "H" Company come under the same category.

Another point that will be noticed is the fall of "A" and "B" Companies' curves in April which is quite different from the others. These Companies occupied the lowest bungalows.

The Effect of Physical Training and Exercise.—Up to July 10, the course of Physical Training and Gymnasium (lasting three weeks) consisted of three parades a day, one three-quarters of an hour before breakfast and two three-quarters of an hour between breakfast and dinner. Acting on my recommendation the Commanding Officer reduced this by abolishing the early morning parade. Apart from the fact that the course is no doubt a strenuous one at such an altitude, I had two main reasons for my recommendation:—

(1) The distance between the bungalows and the parade ground. This particularly affected "A" and "B" Companies. The time between the first and second parades was just sufficient to allow these men to go down to their bungalows, snatch a hurried breakfast, and get back.

(2) The prevalence at that season of digestive troubles, chiefly a more or less mild form of diarrhœa, which tended to become chronic and had the character of hill diarrhœa.

For instance, during the physical training of "C" Company, 11 men lost over 5 lb. in weight, viz.: 6, lost 6 lb.; 1, 7 lb.; 3, 8 lb.; and 1, 9 lb. Seven of these had definitely been suffering from diarrhœa, 1 had an an attack of colic. and 1 had a sore throat and some bronchial trouble. Only 5 of them had reported sick.

"A," "B," "E," and "H" Companies, therefore, had a modified

course, "C" and "D" Companies and also "D" Company (May 2 to 19) had the full course. Of the four companies who did the modified course, 43 per cent lost weight and 46 per cent gained, and the average per man was a gain of 0·65 lb. Of the three other companies 54 per cent lost and 27 per cent gained, and the average per man was a loss of 0·95 lb. Though I am loth to place much value on these figures, I am inclined to think that the original course of physical training was rather strenuous. The balance in favour of the modified course is more evident when we remember the climate conditions before and after July 10.

As regards Company and Field Training there is no evidence from these weights that by itself the training has any bad effect. On the other hand, it serves to accentuate the point that the greatest effect is produced by the climate. There is no doubt that Company Training can be made very strenuous, as the only available training ground is up and down the khud, and it has been necessary to issue a caution on the occasion of a number of men falling out or coming sick directly as the result of a hard day's work.

It was the custom in 1913 to hold *Running Parades* during the rains. These consisted in alternately a double, a quick-time march, and a walk up the cart road for about one and a half miles. From what I gathered from the men I judged that these were the most trying of all their exercises. These parades were stopped in 1914.

The Route Marches in 1914 were considerably reduced in distance and the custom of marching the battalion straight up the short cut to Darjeeling was stopped.

Finally, as regards the effect of physical training, it is interesting to note that three of the four cases of beriberi came from "A" Company. Now it will be asked how can the total absence of the disease from "B" Company be explained, since two companies lived side by side in the group of four bungalows at the lowest and remotest part of the Cantonment, had practically the same food and went through the course of Physical Training together? The only explanation I can offer is that on the completion of their Physical Training at the end of July "B" Company had a month's rest, whereas "A" Company went straight on to Company Training, which lasted the whole of August, the most depressing season of the year.

Diarrhœa.—One very important cause of the loss of weight is the prevalence of digestive troubles, particularly diarrhœa, which presents the symptoms and characters of hill diarrhœa. This disease tends to become chronic, with two or three putty-coloured

stools first thing in the morning. It was rarely of a severe nature, and many of those attacked did not report sick and only a small proportion required admission to hospital. I have given above an

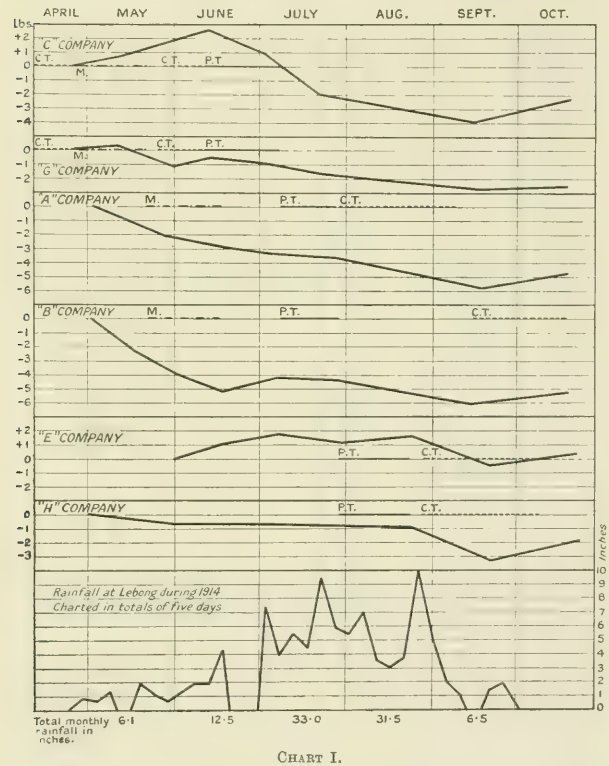

Chart I.

instance of the loss of weight produced in the persons of seven men of "C" Company and also amongst the "contacts."

The following tables, dealing as they do with the more severe cases only, give some idea of the prevalence of this disorder.

Table IV brings out the fact that "A" Company suffered most while "B" Company was nearly as bad.

TABLE IV.—CASES OF DIARRHŒA BY COMPANIES FOR EACH MONTH OF 1914.

	A	B	C	D	E	F	G	H
January, *nil.*								
February ..	..	..	..	..	..	..	1	1
March ..	..	..	..	..	..	..	1	..
April ..	..	1	..	..	..	..	..	..
May ..	1	..	..	*	..	*	..	..
June ..	1	2	1	..	..	..	3	1
July ..	12	11	4	..	3	..	7	5
August ..	5	3	2	..	..	..	..	..
September, *nil.*								
October, *nil.*								
	19	17	7	..	3	..	12	7

NOTE.—* "F" and 1/2 "D" went to Barrackpore.

TABLE V.—MONTHLY INCIDENCE OF DIARRHŒA DURING THE YEARS 1911-1914.

	1911	1912	1913	1914	Total
January, *nil.*					
February ..	..	1	..	2	3
March ..	..	..	..	1	1
April ..	2	..	2	1	5
May ..	2	5	6	1	14
June ..	78	14	5	8	105
July ..	23	9	20	42	94
August ..	9	8	8	10	35
September ..	7	3	3	..	13
October ..	4	2	1	..	7
November ..	..	2	3	..	5
December ..	..	2	..	..	2
	124	46	48	65	283

Table V shows the monthly incidence to be highest in June and July, and it is interesting to compare these figures with the beriberi figures in Table I. At first sight there seems to be a relationship between the two, but after a closer study and reference to statistics for previous years I think the relation is more apparent than real. However that may be, there is no doubt that we must reckon with this diarrhœa as an important cause of loss of weight, and therefore as a factor to be reckoned with as a predisposing cause of beriberi.

Judging from my own experience and that of other officers who have suffered from this complaint, the effects are very great. There is great debility, loss of weight (one officer lost eighteen pounds in a very short time) and impairment of digestion, only the lightest diet of milk and eggs being tolerated.

In the case of the men it is not by any means the rule for them

to report sick; they have two or three motions in the morning and then feel better and are just able to carry on for the rest of the day. At the same time their ordinary diet serves only to aggravate the symptoms and is not digested. This state of affairs may last some time, and the man loses weight and becomes debilitated and all exercise becomes an effort. Then one day being called upon to do a little more strenuous work such as a route march or an "attack" up the khud, he breaks down. When brought to hospital such a man will describle how he felt dizzy and breathless and felt his legs getting weak, and then he vomited.

On examination no symptoms beyond the diarrhœa and vomiting may be present, and with careful treatment and rest the patient may recover without any further developments. On the other hand, the knee-jerks may be absent or may disappear later, and there may be pain and tenderness of the calves and pain on pressure over the epigastrium. Even then no further symptoms may develop under appropriate treatment, but possibly in time undoubted symptoms of beriberi made their appearance.

The conclusions I would draw from these observations are :—

(1) That loss of weight is the rule during the summer and is directly the result of the rains.

(2) That with the advent of the rains digestive disorders become prevalent and have a very depressing influence.

(3) That physical exercise if regulated to suit the altitude is not in itself harmful, but may easily be overdone in the presence of (1) and (2).

(4) That consequently by the operation of (1), (2) and (3) we have a condition produced which predisposes to the development of symptoms of beriberi.

Research Work.

Owing to my many other duties I was unable to carry out any elaborate research, and my efforts were limited to an endeavour to find a causal organism.

Two post-mortems provided me with material. The first case contracted the disease in 1913 and relapsed in 1914 and died of acute dilatation and failure of the heart. The second contracted the disease in 1914 and has been reported above (Case 2).

With material from these post-mortems four monkeys (*M. rhesus*) were inoculated: three received into the peritoneum cerebrospinal fluid, saline emulsion of the medulla and emulsion of the mesenteric glands respectively, the fourth had fifteen minims of cerebro-spinal fluid injected into the spinal column by lumbar puncture.

All the animals showed some loss of weight, but this may have been due to the advent of a cold spell of weather, and one lost appetite and had diarrhœa for a short time; otherwise they remained perfectly well, and a short time after I left Lebong they were allowed to regain their freedom.

Further bacteriological examination of these two cases gave negative results. The microscopic examination of the blood, bile, cerebrospinal fluid, spleen and mesenteric glands revealed nothing. Likewise the cultures remained sterile or showed a few intestinal contaminations.

The pathological findings in each case were entirely those depending on the mechanical effects produced by dilatation of the heart. In the second case the whole of the intestines showed a fine arborescent injection and the mesenteric glands were prominent. Cultures from these glands produced only some common intestinal organisms.

From the vomit of a beriberi patient three bacilli were isolated on a McConkey plate, viz.:—

(1) A non-lactose fermenter turning glucose acid without gas and rendering the media fluorescent.

(2) A non-lactose fermenter and motile, in its reactions corresponding to *fæcalis alkaligenes* and agglutinated up to one in twenty dilutions of the patient's serum.

(3) A bacillus fermenting lactose, glucose, and mannite with gas (dulcite was not available).

I was struck with the large number of the chronic cases that suffered from bad teeth and pyorrhœa alveolaris; one case, a relapse from 1913, had this condition particularly well marked. He was one of the worst of the 1913 cases and had to be readmitted during 1914 with persistent vomiting. Microscopic examination of the vomit revealed quantities of saliva with threads of pus. When the mouth condition was energetically treated the vomiting ceased at once. In many of these cases there was present in the pus a very large bacillus, sometimes segmented and suggesting the mycelium of a fungus, but it was not by any means a constant feature.

Therefore, so far as these observations go, there was no indication of a causal organism, and this was to be expected if we were dealing with true beriberi. The object of the animal experiments detailed above was to eliminate the presence of a "filter passer," but of course the susceptibility of the monkey to the disease is an unknown quantity.

The dogs at Lebong suffer from a curious disease, the symptoms being fever, pains in the back and limbs, weakness of the legs and partial paralysis and loss of weight. Many develop cerebral symptoms and some cases have been mistaken for rabies. I had the opportunity of doing a post-mortem on one such dog, and found acute meningitis. The causal organism was a small streptococcus which grew very slowly and delicately on ordinary media. The dogs which I afterwards treated all recovered under the administration of calomel and a course of liq. hydrarg. perchlor. I mention this disease of dogs because it had been noted by former medical officers and mentioned in their reports as bearing some resemblance to beriberi.

Conclusions.

I think that it may be very fairly concluded—

(1) That the disease is beriberi.

(2) That no evidence of a specific organism has been obtained and there is no evidence that the disease is infectious or contagious.

(3) That the steps taken to prevent the disease at Lebong during 1914 have had a gratifying result. The regiment did not leave behind a single man on account of beriberi when it sailed for England.

(4) That the result has been attained in the first and foremost place by the improvement in the dietary, but also in no small degree by the attention paid to general health, hygienic surroundings and physical exercise.

(5) That climate, climatic diseases (diarrhœa) and physical exercise which is not regulated to meet the conditions obtained at Lebong are important factors in predisposing to beriberi.

Rules and recommendations have been drawn up for the future guidance of the troops at Lebong and it will be very interesting to see the result.

I desire to express my indebtedness to Lieutenant-Colonel J. C. Prettie Perry, R.A.M.C., the S.M.O. of the Station, for his hearty co-operation in the work and for his assistance and his many valuable suggestions, without which it would not have been possible to have brought the work to such a successful issue.

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REPORT FROM THE CEREBROSPINAL FEVER LABORATORY, CAMBRIDGE, JULY, 1915.

By Captain J. F. GASKELL, M.A., M.D., D.P.H.Cantab., F.R.C.P.Lond.

Royal Army Medical Corps (T.F.).

Introduction.

The special Cerebrospinal Fever Laboratory at Cambridge was opened on March 4. In order to make the report for the district as complete as possible, I am also including cases occurring before this date, many of whom were in the First Eastern General Hospital at that time, and whose puncture fluids had been sent to me for examination as Pathologist to the Hospital.

At the beginning of the special work on cerebrospinal fever, I found myself greatly hampered from want of an assistant to carry on the laboratory work while I was away visiting billets and taking swabs of contacts; however, on March 10 Captain Hele very kindly agreed to put in all spare time at his disposal in assisting me, which he continued to do till the end of June. As he was doing this work, the Registrar of the First Eastern General Hospital excused him some of his other duties.

On March 22 I received still further assistance. Mr. Vines was appointed by the Insurance Act Research Committee to investigate the question of the identification of the meningococcus and problems arising therefrom. I put him in charge of the investigation of known strains of meningococci which were being obtained by lumbar puncture. The remarks on the biological characters of the strains of meningococci obtained, as also a considerable part of the work on the identification of the meningococcus obtained from the throat, must therefore be considered as a joint report. Captain Hele was mainly concerned with assisting me in analysing plate cultures obtained from throat swabs, and endeavouring to differentiate and classify the various Gram-negative diplococci found. He kept alive and under observation in subculture for some months many of the strains obtained, and was able to substantiate the constancy of such properties as sugar fermentation in the various groups.

The part of this report dealing with the differentiation of throat diplococci is therefore a joint report of Captain Hele and myself.

The number of cases personally dealt with up to the end of

June is thirty-eight, fifteen of whom died. All these cases were treated at some period of their illness at the First Eastern General Hospital, and all were proved bacteriologically by lumbar puncture.

In addition to these, three doubtful cases were admitted during June, being in all probability mild cases of the disease. Bacteriological proof by lumbar puncture could never be obtained, but in one case an organism apparently identical with the meningococcus was grown from a throat swab.

Three cases occurred who died before they could be admitted to the First Eastern General Hospital. One case, which presumably recovered, was seen in the Northampton Borough Hospital, and left under treatment there.

I have also been informed of three other cases primarily occurring in the district, who died early in the year, one at Bishop's Stortford, and two in the Highland Division, stationed at Bedford. The particulars of these three are here given, as they will not be further referred to in this report:—

(1) Private McI., 1626, 4th Gordons. January 28, First Southern General Hospital, Birmingham, influenza. February 15, Little Bromwich Hospital, C.S.M., March 4, died.

(2) Private T., 861, 6th Argyll and Sutherland Highlanders. March 1, Renfrew (home), from Bedford. March 9, died, C.S.M.

(3) Case died at Bishop's Stortford before February 20. No particulars are known to me.

The percentage of deaths among known cases treated at the First Eastern General Hospital is therefore 39·4 per cent.

If the three doubtful cases are also included, this falls to 36·6 per cent. If all known cases which have occurred in the district are included, the death-rate is 46·6 per cent, which falls to 43·8 per cent when the three doubtful cases are included.

Three convalescent cases were admitted from the Front. As they were well on arrival, and swabs of their throats proved negative, they will not be further referred to.

The method which I have adopted in dealing with cases in the district alloted to me will now be described. Arrangements were made with the Registrar of the First Eastern General Hospital so that, immediately a suspected case was notified, a motor ambulance was sent off and the patient was brought to the hospital and admitted to Ward 19, a portion of which was set apart for cerebro-spinal fever cases. If considered justifiable a lumbar puncture was done as soon as possible. The puncture fluid was examined at once for pus cells and intracellular diplococci or other organisms,

but the diagnosis was never considered to be satisfactorily established till a culture of the meningococcus had been obtained.

While these investigations were being carried out, the medical officer of the unit to which the patient belonged was recommended to isolate the contacts of the case.[1] In certain districts, notably at Peterborough, this was most efficiently and satisfactorily done by making use of the local small-pox isolation hospital. In other places such accommodation was not available, but the medical officer in charge was advised to remove the contacts from the billet in which the case occurred to the largest and best ventilated accommodation available. On a case proving positive, a visit was made by motor, the billet was inspected, and swabs were taken of the contacts. The swabs were sown on the spot on to plates, which were spread on returning to the laboratory. With the assistance of Lieutenant-Colonel Woodhead, an efficient form of travelling incubator was made. The sterilizable plate-carrying case was carried in a close-fitting felt-lined tin, having double walls; the intervening space between these could be filled with water at 37° C., thus acting as a water-jacket to the central cavity. This tin was carried in a wicker basket lined with felt, padded with cotton-wool. The whole apparatus though somewhat bulky could be carried very conveniently in a motor car.

I have carried this apparatus in a car for eleven hours and the temperature has fallen less than 1° C. in that time.

The number of positive contacts in this district has been very small, so that it has been possible to deal with them as follows: They have been admitted to the First Eastern General Hospital and kept there till two throat swabs have proved negative. When the original swabs proved negative, contacts were released and allowed to resume their ordinary duties. Certain contacts from the Norwich district, who have been found repeatedly positive by Dr. Claridge, have also been admitted to the First Eastern General Hospital and have been dealt with by me.

This report will now be treated under the headings given in the scheme prepared in concert by the War Office Committee for Medical History of the War and the Medical Research Committee.

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[1] Contacts were taken to be all men who slept in the same billet, or hut, or who had been in close attendance on the patient after the onset of the disease for any length of time, short or long.

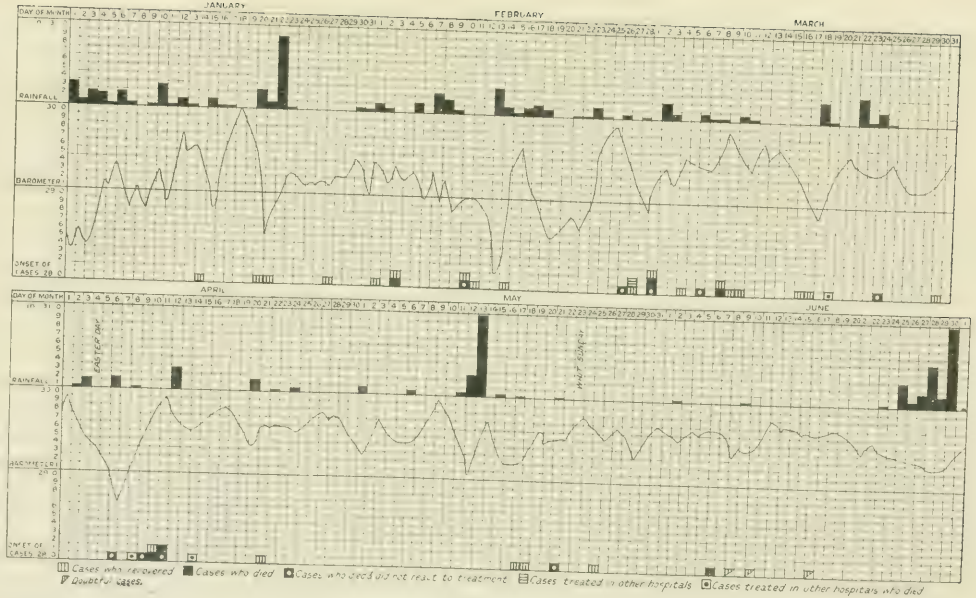

Chart showing for the first six months of the year 1915, the barometer reading and the rainfall in decimals of an inch at Cambridge, together with the date of onset of cases of cerebrospinal fever, which occurred in these months and are dealt with in this report.

I.—Mode of Spread of the Disease.

(*a*) *General Weather Conditions.*—A chart showing the dates of occurrence of cases, the barometer reading and rainfall in decimals of an inch at Cambridge is given in this report; the cases are noted on the day of onset, which in most cases has been quite clear. Usually the onset has been sudden, occurring more frequently in the evening than in the morning. On this chart those cases which have recovered, those which have died, and those which have not reacted in the slightest degree to treatment and have died within five days of onset, are indicated differently. In addition four which were never admitted to the First Eastern General Hospital are shown; of these, three died. Also three doubtful cases are recorded, shown by a triangular marking.

The number of cases is too few to enable any conclusion as to influence of weather conditions to be drawn. The cases have tended to occur on a falling barometer, but usually early in the fall, before the lowest reading has occurred. On the other hand, the largest group, which occurred in April, of eight cases in nine days, followed a very large fall of the barometer, when the subsequent rise was taking place. The lowest reading of the barometer obtained, on February 14, which was accompanied by prolonged rainfall and a very irregular barometer chart for the following days, did not bring on any number of cases, one case only occurring on the 14th itself.

Similarly, the relationship of rainfall to the occurrence of the disease is not very obvious. Twenty-nine cases occurred on days in which no rain fell at Cambridge, while only 16 occurred on days with rain. On the contrary, a conspicuously heavy rainfall, as on January 21 to 23, February 13 to 18, March 22 to 25, was followed by an absence of fresh cases. The recrudescence of the disease in May does seem to bear a slight relation to the heavy rainfall of May 11 to 13, but the first case of this group did not occur till four days later (May 17).

To sum up, there appears to be some relationship between unsettled weather, as shown by rapid variations in the barometer readings, and the incidence of the disease; cases tend to occur with a rapidly falling barometer. The influence of rainfall is apparently slight, but the rainfall at Cambridge is not necessarily an indication of the rainfall at the places where the cases occurred, such as Aylesbury and Maidenhead. Certainly the dry weather which started on April 13 was coincident with the suppression of the main outbreak in this district. The small fresh group of four

cases in May followed at some slight interval a marked group of rainy days, which occurred in the particular dry period in April May and June. It is thus possible that frequent wettings may act as a predisposing cause to the onset of the disease, by lowering the general well-being of the man temporarily—an effect to some extent comparable with that of a previous illness, which, as will be discussed later, seems to have been a factor in a number of the cases.

(*b*) *Particular Circumstances of Exposure to Infection.*—In the particular district with which I had to deal, namely Northamptonshire, Huntingdonshire, Cambridgeshire, Bedfordshire, Hertfordshire, and the Tring Division of Buckinghamshire, a particular focus of infection was not very obvious. Table I gives the distribution of cases for each station and the dates on which these occurred; the only places in which a considerable number of cases occurred are seen to be Bedford and Peterborough. The cases in both these towns are seen to be scattered fairly regularly throughout the early part of the year, and can hardly be looked upon as forming anything in the nature of an epidemic. The rest of the table is remarkable for the occurrence of only one or two cases in a particular locality, and if more than one, they are frequently separated by a prolonged interval. The small outbreak which occurred in the huts of the 11th Suffolks, stationed at Cherry Hinton, Cambridge, is of interest, as five cases occurred within a month; the conditions under which this outbreak took place will be dealt with in the next paragraph (*c*).

There is therefore nothing to point to any particular place in the district in which conditions were more favourable for infection than in any other.[1]

By far the larger number of cases occurred when the men were in their billets or huts, but in five cases the man became ill while on leave in his own home. The full details of each case are given in Table I. In the case of A., on leave for fourteen days when attacked, it is possible that infection took place at home; in the other four cases, those of R., M., Mt., and An., this possibility is to be borne in mind, though the first three had only been on leave three days; the last was doing his training by going to London daily and sleeping at home. The fact that R. and M.

[1] There was no other series at all comparable with that at Cherry Hinton. I am fully aware that in the absence of any statement of the number of troops at any place, which I am unable to supply, this remark can only be taken as representing an opinion.

both became ill at Littleport within eight days of each other may have been due to their infection on arrival at Littleport from some local source there.

In some other cases the possibility of infection while on leave must be considered. In ten cases it was ascertained that the men had not been on leave at all for over a fortnight, but in eleven cases fairly recent leave had been given or the men had been recently shifted from some other district.

If it is allowed that infection took place during this leave, the following places would be eliminated as sources of infection: Bishop's Stortford, Houghton Regis, St. Albans and Saffron Walden. It is of interest in this connexion to note that in 6 cases the men were on leave in places in which considerable numbers of cases have, I believe, occurred—in 2 cases Birmingham, in 3 cases some part of London, and in 1 case Norwich.

The question of leave is brought out very strongly in the group of exceedingly fatal cases in April; out of 9 cases in the month, in 6 a history of recent leave was obtained, and in the other 3 no particulars were got. None of these 3 men was ascertained not to have had recent leave. In 5 cases the disease appeared within two days of the man's return from leave, a point which is worth considering when discussing the question of the incubation period.

Another question also arises in regard to the particular circumstances of exposure, viz., the debilitating influence of a previous illness. I am strongly of opinion that the previous illnesses observed were not an early mild stage of cerebrospinal fever itself, but were correctly diagnosed, and acted as a predisposing cause for the later, often extremely acute, commencement of the attack of cerebrospinal fever.

The particulars are given in the final column in Tables II and III. In six cases a definite previous illness had occurred, in five of which the man had recovered sufficiently to be sent home on sick leave (Table I).

I therefore regard the lowered health thus produced as also acting as a predisposing factor in some cases. One other point has also cropped up. Three cases have occurred in men recently inoculated against typhoid fever. In the case of J., this had taken place twelve days before, and is therefore probably negligible; in the case of D., the second inoculation had taken place four days previously, and in the case of Y. the first inoculation was practically coincident with the onset of the disease. Seeing that

very large numbers of troops were being inoculated at the time of the main incidence of cerebrospinal fever, it is almost impossible to regard these cases as more than coincidences; it is just conceivable, however, that in these cases the malaise following inoculation may have been a contributory cause to the ease of infection.

TABLE I.

Station	First day's illness	Name	Previous leave. Days before	Dates	Place
Amersham, Bucks ..	1·3	C.	?	..	..
Bedford	26·2	My.	None	..	..
,, ...	27·2	Wx.	?	..	..
,, ...	6·3	Ht.	None	..	..
,, ...	8·3	Js.	?	..	..
.. .. ..	10·4	Rw.	?	..	..
,, ...	25·5	Ty.	Visited by friends the day before.		
,, ...	8·6	O.	13 days	22.5 to 26.5	Ashford, Kent.
Bishop's Stortford ..	14·4	Br.	1 day	10.4 to 14.4	Unknown.
Cambridge	14·1	B.	?	..	..
,, ...	20·1	Rk.	?	..	..
,, ...	21·1	Jh.	?	..	..
.. .. ..	1·2	Ak.	?	..	..
.. .. ..	10·2	Hs.	?	..	..
Diss, Norfolk ..	9·4	F.	See Dr. Claridge's report.		
Feuny Stratford ..	9·3	H.	None	..	..
Hemel Hempstead ..	16·6	Me.	?	..	..
High Wycombe ..	10·2	G.	?	..	..
Houghton Regis ..	6·4	Bd.	1 day	1.4 to 5.4	Birmingham.
,, ..	21·5	Dn.	7 days	Moved from	Hitchin.
Kettering	1·3	Wr.	None	..	..
Littleport	3·2	R.	4 days	On leave	from Bury.
,, ...	11·2	M.	3 days	On leave from	Felixstowe.
Maidenhead ..	10·3	Tp.	None	..	..
Northampton ..	27·2	Hk.	?	..	..
,, ..	16·3	Tu.	1 day	13.3 to 16.3	Birmingham.
,, ..	24·3	As.	?	..	..
,, ..	18·5	Wd.	None	..	..
Peterborough ..	3·2	Ss.	?	..	..
,, ..	4·3	St.	2 days	27.2 to 2.3	Norwich.
,, ..	17·3	N.	14 days	3.3	Unknown.
,, ..	30·3	Tm.	None	..	..
,, ..	8·4	Gr.	?	..	..
,, ..	10·4	D.	12 days	26.3 to 29.3	Docking, Norfolk.
St. Alban's	21·4	Sw.	4 days	17.4 only	Bermondsey.
Saffron Walden .	14·2	Bo.	7 days	For firing	Luton.
Stansted	27·1	Mr.	?	..	..
Towcester	8·3	Y.	None	..	..
,, ...	19·3	Ct.	None	..	..
Watford	11·4	An.	Daily to London for drill.		
,, ...	11·4	J.	1 day	5.4 to 10.4	Streatham.
,, ...	17·5	Yg.	None	..	..
Whittlesford, Cambs	1·3	A.	14 days on leave from		Bury St. Edmunds.
Wilburton, Cambs ..	10·6	Cl.	?	..	..
Worthing, Norfolk ..	6·6	Mt.	3 days on leave from		Colchester.

TABLE II.

Recovered. Name	Date of onset	Days to admission	Length of illness	Days in hospital	Age	Length of service	Catarrh at onset	Cubic space in billet per man	Floor space per man	Ventilation area per man	Number of contacts	Fatigue	Previous illness
Tm. ..	30.3	1	11 days	73	17	5 months	No	468	52	3	1	No	No.
Rk. ..	20.1	1	11 ,,	18	27	10 weeks ..	,,	C.H.	C.H.	C H.	?	,,	,,
H. ..	9.3	3	15 ,,	48	20	7 months	Yes	322	40		7	,,	,,
Tv. ..	25.5	1	15 ,,	52	19	7 ,,	No	327	38 5	1½	3	,,	,,
Wg. ..	27.2	5	21 ,,	72	17	7 ,,	?	400	50	1⅓	6	,,	Influenza, 22.2 to 26.2.
Wd. ..	18.5	3	22 ,,	74	18	9 ,,	No	493	58	1⅓	1	,,	No.
Yg. ..	17.5	5	25 ,,	55	26	6 ,,	,,	540	60	1	1	Yes	,,
Wr. ..	1.3	9	25 ,,	54	23	4 ,,	,,	576	72	1½	1	No	,,
Tp. ..	10.3	4	26 ,,	50	19	7 ,,	,,	459	54	1	1	,,	,,
*Mr.** ..	27.1	28	28 ,,	10	21	7 years ..	,,	?	?	?	?	?	?
Bo. ..	14.2	3	30 ,,	71	18	6 months	,,	197	26	1	3	No	No.
*G.** ..	10.2	27	32 ,,	48	38	4 ,,	,,	?	?	?	?	?	?
Sw. ..	21.4	3	36 ,,	40	26	4 years ..	,,	525	60	3¾	2	No	No.
N. ..	17.3	3	38 ,,	43	19	6 months	,,	866	97	4½	1	,,	,,
St. ..	4.3	7	41 ,,	53	21	6 ,,	,,	470	55	3	7	,,	Sore throat, 7.2 to 27.2.
Ak. ..	1.2	4	48 ,,	87	22	4 months	,,	C.H.	C.H.	C.H.	?	Chronic ill-health	No.
R. ..	3.2	30	56 ,,	61	22	6 ,,	,,	Home	Home	Home	?	No	,,
Js. ..	8.3	7	62 ,,	76	27	5 ,,	?	?	?	?	None	?	?
M. ..	11.2	29	64 ,,	59	24	3 ,,	No	Home	Home	Home	,,	?	?
B. ..	14.1	9	72 ,,	94	19	?	?	C.H.	C.H.	C.H.	?	?	?
Tu. ..	16.3	1	86 ,,	137	26	6 months	No	765	90	5	1	No	Influenza, 2.3 to 7.3.
Rw. ..	10.4	5	100 ,,	106	23	6 ,,	,,	?	?	?	None	?	No.
Jh. ..	21.1	8	102 ,,	94	17	3 ,,	,,	C.H.	C.H.	C.H.	?	?	?
Doubtful Cases.													
Cl. ..	10.6	1	11 days	34	20	7 months	No	C.H.	C.H.	C.H.	?	No	No.
O. ..	8.6	2	26 ,,	51	19	8 ,,	,,	240	30	1½	5	,,	,,
Me. ..	16.6	5	26 ,,	40	28	6 years ..	,,	?	?	?	?	?	?
Cases Treated Elsewhere.													
Hk. ..	27.2	..	Treated at Northampton Borough Hospital				No	852	44	3½	1	No	No.

* Convalescent on admission.

C.H. — Cherry Hinton huts, Cambridge.

TABLE III.—Fatal Cases.

Died. Name	Date of onset	Days to admission	Length of illness	Days in hospital	Age	Length of service	Catarrh at onset	Cubic space in billet per man	Floor space per man	Ventilation area per man	Number of contacts	Fatigue	Previous illness
Bd. ..	6.4	Days 1	36 hours	Hours 12	20	6 months	No	333	33	$\frac{5}{8}$ sq. ft.	8	No	No.
Hs. ..	10.2	Hours 12	1½ days	Days 1	36	3 ,,	,,	C.H.	C.H.	C.H.	?	?	?
As. ..	24.3	Days 2	4 ,,	2	21	3 years ..	?	?	?	?	2	?	?
C. ..	1.3	3	4 ,,	1	?	?	?	440	52	*Nil*	8	?	?
J. ..	11.4	1	5 ,,	4	34	2 years ..	No	380	45	2½	6	No	Inoculation 12 days.
Dn. ..	21.5	1	5 ,,	4	19	7 weeks ..	,,	Army tent	..	..	10	,,	No.
F. ..	9.4	3	5 ,,	2	19	1 year ..	See Dr. Claridge's Report.						
Ht. ..	6.3	4	5 ,,	1	18	2 years ..	No	Good	..	Good	?	?	Convalescent from measles.
My. ..	26.2	2	5 ,,	3	24	?	,,	375	50	4½	1	No	No.
Mt. ..	6.6	11	15 ,,	4	41	10 months	,,	Home	..	Home	30	,,	,,
Ss. ..	3.2	4	19 ,,	15	17	3 ,,	,,	?	?	?	?	?	?
An. ..	11.4	2	23 ,,	21	17	4 weeks ..	,,	995	117	7½	2	?	?
A. ..	1.3	4	49 R.*	45	21	29 ,,	,,	Home ,,	Home	Home ,,	?	No	Influenza: home 7 days.
D. ..	10.4	4	51 days	47	20	3 months	,,	640	80	5½	13	Inoculation, 6.4	Cold 29.3, 12 days.
Y. ..	8.3	4	63 ,,	60	22	5 weeks ..	Yes	480	60	1	2	Inoculation, 8.3	No.

TABLE IIIa.—Fatal Cases not admitted to First Eastern General Hospital.

Died. Name	Date of onset	Length of illness	Age	Catarrh at onset	Cubic space in billet per man	Floor space per man	Ventilation area per man	Number of contacts	Fatigue	Previous illness
Br.	14.4	5 days	?	No	322	46	2½	2	No	10.4. Not quite well.
Ct.	19.3	1½ ,,	?	Yes	540	72	1	1	No	No.
Gr.	8.4	12 hours	?	No	576	72	1½	1	No	No.

* R = Relapse. C.H. = Cherry Hinton huts, Cambridge.

To sum up: there is a distinct connexion between the giving of leave and the incidence of cases in this district, men thus becoming exposed to infection and either developing the disease while on leave or within a fairly short time after returning—in some cases almost immediately after. A previous illness also is a factor in predisposing any particular individual to an attack, acting by reducing resistance in the same way that weather conditions, already discussed, also do.

(*c*) *Overcrowding and Lack of Adequate Ventilation.* — The cubic space per man found in billets and the ventilating area are given in each case in Tables II and III. The number of cases in which this cubic space has been ascertained to be 400 cubic feet or less is 11; the number in which it has been above this is 15. In this latter group, however, in 1 case the ventilation was practically *nil*, the men being billeted in a garage; in 4 cases the ventilating area was below 2 square feet per man, and in 3 other cases it was below 4 square feet. In only 7 cases of the 26 in billets were the conditions of cubic space and ventilation adequate. In one of these, at any rate (Tu.), the man had returned the day before from sick leave following an attack of influenza; the billet conditions had therefore little to do with his attack.

The conditions in the huts at Cherry Hinton, Cambridge, in which the cases in the 11th Suffolk Regiment occurred, are interesting; the letters C.H. in Tables II and III refer to these huts. The cubic space per man was 200 cubic feet, 30 men being in each hut and the ventilation area 2 square feet per man. Five cases occurred here within a month very early on in the year (*see* Table I); and during this period facilities available for ventilation were little made use of. Lieutenant-Colonel Woodhead, however, took the matter in hand and secured adequate ventilation, with the result that the disease completely ceased, and no further cases were observed through the rest of the period in which cases were occurring elsewhere. I conclude, therefore, that insufficient cubic space per man and inadequate ventilation are powerful predisposing causes.

(*d*) *Fatigue.*—This factor is also tabulated in Tables II and III, and is, in my opinion, of very little importance.

In almost all cases the men had been carrying out their ordinary duties and had had no extraordinarily hard work. In one case, Ak., the man had been in chronic ill-health and therefore was liable to be easily over-fatigued. In the case of Yg., his regiment was marching from Watford to Saffron Waldron, and Yg. was taken severely

ill on the way. He was, however, already out of health on the day he started from Watford. Fatigue, therefore, seems of little importance.

(*e*) *Age of Patient.*—As is seen in Tables II and III the ages range from 17 to 42. Twenty-three cases occurred in men between the ages of 17 and 22, of whom 9 died; 13 occurred in men between the ages of 22 and 30, of whom 2 died; and 4 between the ages of 34 and 42, of whom 3 died.

As the number of young recruits in the forces stationed in my district considerably outnumbered men of a more mature age, little can be argued concerning susceptibility according to age; on the whole it is probable that the percentage incidence was fairly uniform. The death-rate, however, varies considerably, being 40 per cent. under 22, and only 15 per cent. between 22 and 30.

Among the few older cases, however, it is high, being 75 per cent. It appears, therefore, that the chances of recovery increase with arrival at full maturity, while over 30 years they again diminish. The figures are small as a basis of inference, but the percentage difference is large.

(*f*) *Length of Service in the Army.*—This is also tabulated in Tables II and III, and ranges from four weeks to seven years. Of those under four months' service 6 out of 9 died, while among those of longer service, but recruited since the outbreak of war, only 2 out of 20 died. The outlook is apparently worse, therefore, in fairly recent recruits. The incidence of the disease does not appear to depend on the length of service in any way.

(*g*) *Catarrh* is, in my opinion, not a predisposing factor, and the catarrhal stage of the disease, as described by the Aldershot workers, is remarkable by its absence. In only one case, that of Corporal H. was there any definite sore throat at the onset. The remarkable thing about many cases was the extreme suddenness of definite meningeal symptoms in a man previously absolutely well.

II.—Contacts.

The identification of the meningococcus from the throat is a matter of difficulty in our experience. The tests recommended have been mainly relied on, namely the power of growth at 23° C. and the power to ferment glucose and not saccharose. Other sugars have also been tried and will be referred to later.

We do not consider for many reasons that these methods are in our hands entirely satisfactory.

We have studied, often for months, the properties of various

strains of meningococci obtained by lumbar puncture, and have used them for comparison with organisms obtained from the throat. With one exception all these meningococcus strains have been uniform in fermenting glucose in fluid solution to a greater or less degree, that is to say, to an extent which is identifiable with certainty if control tubes are used. The one case (Tu.), a strain of which has been submitted to the laboratory at the Royal Army Medical College, for a long time did not ferment glucose. After about three months' artificial cultivation, however, it gradually gained, or rather manifested, the power to do so. The probable explanation of this will be discussed later, when treating of the nature of the sugar reaction.

A few difficulties met with will first be discussed, and then the value and reliability of the tests.

(1) *Vitality.*

An initial difficulty was found to be the successful subculture of a particular strain. This holds not only for the meningococcus but also for other types of Gram-negative diplococci as well. If sown from the culture in the ordinary way in minimal amounts the subculture usually fails to grow. If, however, a large amount sufficient to cover the needle is taken, subcultures can almost always be successfully obtained. Another point is to select a tube or plate freshly made with plenty of moisture—a subculture has often failed owing to the tube on which it was made being too dry. The difficulty mainly arises when the strain is first obtained, and it is worthy of note that it has practically never arisen in the tube in which the first sowing from a plate has taken place, but quite frequently at the second subculture. However, with the precaution of sowing very thickly on to a moist tube strains practically never fail to subculture. With the media supplied, the only safe method to preserve a strain has been daily subculture. We, however, now find that a cornflour starch medium, recommended by Vedder, and suggested to us by Dr. Flexner, of New York, will keep the organisms alive on slopes for four to six days and in stabs for as long as a fortnight.

(2) *Streptococcal Contamination.*

Owing to the necessity of subculture in mass it has frequently been extremely difficult to eliminate streptococcal contamination.

As these organisms ferment both glucose and saccharose with rapidity, errors in fermentation tests can only be safeguarded by always subculturing at a suitable interval the sugar tubes used.

(3) *Constant Temperature in the 23° C. Incubator.*

Unless checked by keeping a chart of readings of a maximum and minimum thermometer, quite large variations in temperature may be missed, especially at night. This was a source of error early in our work.

(4) *Want of a really Successful, Constant and Easily Sterilizable Sugar Solution.*

In our experience the mixture recommended in Major Gordon's report is an extremely tricky one to make up satisfactorily with certainty, more especially in the case of glucose. The trouble appears to be the exact point in neutrality necessary for successful sterilization and to prevent subsequent alteration in colour on incubation. Frequently two or three days' incubation changed the original blue colour of the litmus to a dirty brownish-blue, in which small changes of acidity, such as many meningococci give, are very difficult to detect. This may partly depend on the glucose used ; for instance, a sample sent us from the Royal Army Medical Corps store at Woolwich was absolutely useless, becoming strongly acid merely as the result of a day's incubation. As the meningococcus reaction takes on the average four days to become undoubtedly plain, this question of slow breakdown of sugar solutions is a very important one. The addition of fresh serum also renders the possibility of contamination a factor, but by making use of the sterilizable bulb filler invented by Dr. Cobbett we have had no trouble from this source, with the exception of the occasional use of serum already contaminated in bulk.

The complicated proteid mixture present, lemco or veal broth, peptone and fresh serum, when such a delicate reaction is being tested, is eminently undesirable, and considerable numbers of experiments have been undertaken in an attempt to improve on this. We are now working on a cornflour starch mixture which is promising, has the advantages of comparative simplicity, an easily obtainable sky-blue colour, and can also be sterilized completely in the same manner as peptone water sugars.

(5) *The Slowness of the Reaction of Sugar Media with both Meningococci and certain other Groups.*

We endeavoured to overcome this by making use of a different indicator, using neutral red instead of litmus, as its neutral point is much more on the alkaline side and much sharper than that of litmus. While this indicator showed change two or three times as quickly as litmus, it was not found that the change of colour was sufficiently distinctive in certain groups. It distinguished quickly the groups that we call *pharyngis siccus*, von Lingelsheim, and *flavus I*, the change being complete overnight, but in the other groups the change was not sufficiently marked to be absolutely reliable. It is, however, of some value in quickly eliminating the groups mentioned. An additional drawback is that the strain of *Micrococcus catarrhalis* that we used also caused a slight acid reaction in glucose with this indicator. This will be further referred to in discussing the nature of the sugar reactions. Solid media were also to some extent tried, but were found to be even less reliable than the fluid media, so their use was abandoned.

Growth in the Cold Incubator at 23° *C.*—In our experience this is a useful help to differentiation, but is open to fallacies, and taken by itself cannot be a safe guide.

The occurrence of *copious* growth at this temperature overnight or within two days is sufficient to eliminate any particular organism, but for the differentiation of the more difficult groups it is, in our experience, merely confusing.

For instance, some strains of meningococci when first obtained undoubtedly showed slight growth in forty-eight hours, more especially if sown on blood agar. The growth, though slight, was quite distinct. On the other hand, certain individuals in the groups we call *flavus II* and *III* have shown no growth at a lower temperature than 24° C. and only grow feebly between 24° C. and 25° C.

It may also be mentioned here that constant subculture at 37° C. has definitely removed the power to grow at 23° C. in practically the whole group of Gram-negative diplococci which have been obtained from the throat and studied. A series of thirty-two strains belonging to different groups have been under study for some weeks, the longest having been under culture for over four months, and except in the group *flavus I*, in which feeble growth occurred in three to four days, the amount of growth was negligible. On transference to the 37° C. incubator on the fifth day, luxuriant growth was obtained in all tubes.

The minimal temperature for a particular organism of the Gram-negative group is therefore a variable factor. Another fallacy, which may occur in using the cold incubator test, is due to the question of the vitality of the subculture and the necessity of thick sowing. This has been guarded against by always transferring tubes back to the hot incubator on the third day, and only counting the test satisfactory if growth then occurs. All strains of meningococci met with grow freely in the hot incubator after having been in the cold three days.

Differentiation by the Sugar Reactions.—This is the method which has been mainly relied on, and the following provisional classification has been made of the group of Gram-negative diplococci as found in the posterior pharynx; the groups are given and also their sugar reactions. Thirty-two organisms have been selected and thoroughly and frequently tested over a prolonged period:—

Organism	Glucose		Saccharose		Mannose		Galactose		Inulin	
	Reaction	Time in days	Reaction	Time in days	Reaction	Time in days	Reaction	Time in days	Reaction	Time in days
M. pharyngis siccus	+	1	+	1	+	1	–			
M. flavus I ..	+	1 or 2	+	2	+	3	–		-	
,, *II* ..	+	4	+	1	+	4	–			
,, *III* ..	+	3 or 4	a	..	+	3 or 4	–			
M. catarrhalis	a	..	a	..	a	..	–		–	
Meningococcus	+	4	a	..	+ a	3 7	–		–	

+ = acid. a = alkaline. – = no change.

M. pharyngis siccus is an extremely adherent organism, growing freely on the media used, and often in a young culture forming a skin which can be removed off the surface of the colony. Later the whole colony becomes densely adherent. These characters may be lost quite quickly on subculture and the culture resemble closely that of a meningococcus. The colour is white. It grows freely in the cold at 23° C. and ferments glucose, saccharose, and mannose with rapidity, the reaction usually being practically complete in twenty-four hours. Under a low power of the microscope the colony is a clear orange brown.

M. flavus I.—Yellow in colour. The colonies tend to slide about over the surface of the medium and can be picked up whole by the needle. In some of this group, however, the organism has a more stringy growth, fairly easy to get on the needle but difficult to sow off again. It grows freely in the cold at 23° C., and ferments glucose, saccharose, and mannose, but not so rapidly as *M. pharyngis*

siccus. Usually the reaction takes two to three days to be complete, though showing in glucose in twenty-four hours as a rule.

M. flavus II differs from the preceding group in being much more delicate, and fermenting the sugars much more slowly and often less completely.

It is also yellow in colour. The colonies tend to coalesce into a rather sticky mass, often coming away in strings when touched by the needle; it is, however, usually easier to sow off than similar organisms of the group *flavus* I. It grows feebly in the cold at 23° C. in forty-eight hours. It ferments glucose, saccharose and mannose, but no distinct change is often apparent under three to four days, the time of reaction approximating to that of the two groups *flavus III* and the meningococcus. Often the change is first apparent in the saccharose tube rather than the glucose one, probably owing to the greater ease with which a satisfactory saccharose tube can be made.

This organism is comparatively rare—only having been met with on three occasions for certain.

M. flavus III.—Yellow in colour, but usually more of a canary-yellow than *flavus I* and *II*. The consistency of a colony resembles paint, and is thus very like that of the meningococcus.

With respect to its growth in the cold at 23° C. a subdivision may be made, *IIIa* growing strongly in the cold in twenty-four hours, *IIIb* refusing to grow at all at 23° C. and only growing slightly at 24° to 25° C. It ferments glucose and mannose, the reaction being evident in four days, but does not ferment saccharose.

M. catarrhalis.—This organism was only met with early in the investigation, and only one strain survived to be put through extended tests. Growth is like paint, easily emulsified in water. The colour is white. In the cold at 23° C. its power of growth was at first small, doubtful results only being obtained. Later after subculture for some weeks it failed to show any growth in forty-eight hours.

It did not ferment any of the sugars, though a slight temporary change became sometimes evident in glucose tubes on the third day. Both glucose and saccharose tubes were by the fourth or fifth day markedly alkaline.

Meningococcus.—The growth is like paint, easily emulsified, and the colour is white or very faintly tinged with yellow. In the cold at 23° C. it usually does not grow at all, but slight growth has been occasionally observed. It ferments glucose in about four days but not saccharose. The reaction with mannose is of interest as it

apparently differentiates it quite distinctly from *flavus III.* At first in about three or four days a slight but distinct acidity appears, later in six or seven days this has completely disappeared, and the tube may even become more alkaline than the control.

The acid change is always temporary and always slight.

The Sugar Used.

(1) *Glucose.*—The reactions of the various groups have already been given, all fermenting glucose except *M. catarrhalis.*

The difficulties in getting an efficient mixture have already been touched on.

(2) *Saccharose.*—Fermented by *flavus I* and *II* and *M. pharyngis siccus;* not by any of the others.

Never any serious difficulty in getting a good medium.

(3) *Mannose.*—The sample used was Kahlbaum's. Fermented by *M. pharyngis siccus, flavus I, II* and *III* but not by the meningococcus to any extent. Not by *catarrhalis.*

The experiments with mannose are at present few, and the value of this sugar to differentiate the meningococcus and *flavus III* is to be further tested.

(4) *Galactose.* — Specially made and purified by Professor Hopkins, of the Biochemical Laboratory, to whom our best thanks are due. We have tested this sugar on our strains three times in all, and have never found the slightest sign of fermentation with any Gram-negative diplococcus even at the end of a week. The organisms all grew well, and subcultured freely out of the medium. We therefore are in agreement with Elser and Huntoon on this point, and presume that the positive results obtained by other workers are due to difficulties in getting a reliable medium. We have ourselves found that still greater care is necessary with this sugar than is the case with glucose.

(5) *Inulin.*—This was tried as the power of the meningococcus to grow on starch was found to be so marked. The results were throughout negative.

We are well aware that the differentiation, as far as throat organisms are concerned, is incomplete, and that other organisms, such as the pseudo-meningococcus, are included in our meningococcus group. We are therefore hoping to investigate the removal of agglutinating power, which in the hands of Elser and Huntoon seemed to be of considerable value.

The differentiation by fermentation is, however, probably good enough for practical purposes, as the organisms which would be

included wrongly in the meningococcus group are not widespread.

By far the greater number of the Gram-negative cocci met with fall in the first two groups *pharyngis siccus* and *flavus I*, which are both easily eliminated.

The direct differentiation on the primary plate by means of incorporating glucose and neutral red has been advocated by Buchanan, but our experience leads us to believe that this method is open to grave objection, and has many fallacies.

Our working method is, therefore, to get a pure culture, and then sow in bulk into glucose and saccharose broth. A culture is also sown on a slope and put in the cold incubator. A stock culture is also made in a starch stab in case further tests are necessary.

On the second or third day a subculture is made from the broth tubes to establish growth in them of the pure organism, and if no growth is apparent on the tube in the cold incubator, this is then transferred to the hot incubator to be sure the culture is alive. If the organism gives the sugar reaction of the groups *flavus III* or meningococcus, it is also sown into mannose. By the summation of the results of these tests the organism can usually be differentiated accurately. In our opinion the whole of these tests must be rigidly performed in the case of a doubtful organism.

The groups *M. pharyngis siccus* and *flavus I* are, of course, easily eliminated with certainty by the sugar tests or cold test alone.

As has already been mentioned, we do not consider the sugar media entirely satisfactory, and think that there is room for improvement in this direction.

The differentiation of the meningococcus from closely allied organisms, such as pseudo-meningococcus, also is desirable. The differentiation of the meningococcus and *M. catarrhalis* also is a matter open to argument, more especially in the light of the occurrence of diplococci from the fluid of true cases of cerebrospinal fever, such as that of Tu. in one series, which do not ferment glucose. The cold incubator test is also not conclusive, as the few strains of *catarrhalis* that we have tested have grown very feebly at 23° C. Investigations that Mr. Vines is now making on the nature of the ferment action of these organisms may throw further light on this matter.

The present position of this research may be briefly sketched. It has been found that meningococci grown in a fluid medium similar to that used for testing sugars, but with the sugar left out

and just distinctly acid in reaction, in the course of a week or ten days commence to turn the medium more and more alkaline. The strain from Tu. was notably rapid in doing this, about twice as quick as any of the others tested. This alkali production is in all probability due to proteolysis, whether due partly to an extracellular ferment or not is at present uncertain.

On the other hand, from sugar tubes in which fermentation of glucose has taken place, a ferment can be separated which will cause acid production from glucose in a sterile medium, the sterility being checked from time to time by subculture. By the processes employed the bodies of bacteria are almost entirely removed.

It appears, therefore, that in a sugar fluid medium a double action is going on: an acid production from sugar due to an extracellular ferment and an alkali production from the protein present. The curious case of Tu. could thus be explained, the unusually rapid production of alkali masking the acid ferment reaction. It is possible also that *M. catarrhalis* has a similar double fermentative power, and that the alkali production is still more rapid. Indications have already been given that a slight acid reaction may appear in the early days of the fermentation. At any rate, the production of a strong alkaline reaction is a very marked feature of the growth of *M. catarrhalis* in glucose broth, and occurs very early. Further researches on these lines are being carried on.

The agglutination reactions of a number of strains of meningococci have been also studied by Mr. Vines by the macroscopical method, and the reactions at the end of four days are shown in the accompanying Table IV. The strains were tested against a polyvalent serum kindly sent me by Dr. Flexner from the Rockefeller Institute in New York, against a serum of one of the patients (D.'s serum) and against Mr. Vines' own serum, which was taken as a normal serum.

As is seen in the table the results with the different strains vary considerably. With normal serum only one, however, was completely agglutinated at a dilution of 1 in 10, and it is remarkable that this strain was also only agglutinated by the Rockefeller serum at the same dilution though tried twice. With D.'s serum, however, complete agglutination was also obtained at a dilution of 1 in 100. Both the Rockefeller and D.'s serum agglutinated all strains at 1 in 10 except in one case with D.'s serum. At 1 in 100 D.'s serum agglutinated all but three completely, while the

Rockefeller failed completely to agglutinate seven. At 1 in 1,000 complete agglutination occurred three times with D.'s serum and not at all with the Rockefeller serum.

TABLE IV.

B. *Final result. Agglutination.*

Strain	Rockfeller serum				D.'s serum			Normal serum			Time = 4 days
	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{500}$	$\frac{1}{1000}$	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	Notes
D. ..	+	+		p	+	+	+	s	s	s	Chronic case.
J. ..	+	+		−	+	+	+	p	s	s	Acute case.
An. ..	+	+	p	..	+	+		s	s	s	Chronic case.
A. ..	+	p	..	s	+	+	p	p	p	s	Chronic case.
As. ..	+	p	..	s	+	+	+	p	s	s	Acute case.
	+	+	..	p							
F. ..	+	p	..	s	+	+	p	p	s	−	Acute case.
Sw. ..	+	+	..	p	+	p	s	s	−	−	Chronic case.
Tm. ..	+	−	..	−	+	+	p	+	p	s	Mild case.
	+	s	..	−							
N. ..	+	p	..	s	+	p	s	p	p	s	Mild case.
Rw. ..	+	p	..	p	p	p	s	p	s	−	Chronic case? Sugar reactions.
Tu. ..	+	+	..	−	+	+	p	p	s	s	Chronic. No sugar reactions.
Bd. ..	+	+	..	−	..	..	..	..	..	..	Acute case.
Tm. throat	+	p	..	s	+	+	p	p	s	s	Mild case.

+ = complete reaction. p = partial. s = slight. − = no reaction.

The results obtained vary so considerably among these known meningococcal strains that all idea of using the agglutination reaction for the differentiation of throat cocci was abandoned. Our conclusions are thus in agreement with those of Gordon, Elser and Huntoon and many other workers. Even the Rockefeller serum is shown to be quite unreliable at a dilution of 1 in 100. As has been mentioned elsewhere, we are hoping to investigate the method of absorption of agglutinations, on which Elser and Huntoon report so favourably.

III.—Carriers.

The number of positive contacts or carriers encountered depends entirely on the strictness with which bacteriological differentiation is carried out, and is to that extent unsatisfactory, as our methods of differentiation are at present difficult and still almost in the experimental stage.

In my particular district the number of contacts per case was very small, averaging under four per case, so that the total number

of contacts examined has been small. This is due to the great majority of cases having occurred in billets.

From my district 155 contacts in all have been examined, 7 of whom have been positive, giving a percentage of 4·5. One of these was found early on in our work, and is probably doubtful, which would reduce the percentage still lower. Three positives had to do with one case (Yg.), one of them being a man billeted with him, and two others men who followed on in the billet three or four days after the patient had left. This would point to an intermediate carrier, or might merely be a coincidence. An intermediate carrier could, however, not be found.

A good many of the positive carriers dealt with have been men from the Norwich area, sent to us by Dr. Claridge, who had found them repeatedly positive. We have also had some patients whose throats contained the meningococcus when they were in the convalescent stage. When the main epidemic was declining the staff of Ward 19 was examined, and among eleven nurses and seven orderlies all were negative except one. This positive was the ward-master, who had only been in the ward ten days. I was then inclined to suppose that it was possible that a positive phase had also been passed through by some of the other members of the staff, who had all been in the ward for a month or more. But quite recently a swab from the throat of this ward-master (Corporal W.) has again turned out positive, so it is more likely, as he has so constantly yielded cultures for months, that he is a more efficient carrier than the others, and that his case affords no evidence that a transient phase is frequently passed through.

I do not, however, think that the probability of a transient positive phase is at all unlikely; if true, it would assist considerably in elucidating the extremely scattered incidence of the disease, the intermediate carriers being practically impossible to trace. For instance, this may well have happened in the case of the three contacts of Yg. Other evidence of value in support of this is the fact that some of the contacts found positive on first swabbing have been found to be negative by the time (about a week) that the examination of the swab has been completed and they have come into the hospital.

As my experience is so small, answers to most of the headings in Section III would be valueless. I may only remark that our experience of nasopharyngeal catarrh in carriers is entirely negative. I have, on the contrary, been struck by the absolutely normal condition of all throats in which the meningococcus has been found.

Plenty of throats[1] have been examined in which signs of catarrh have been seen, but have all proved negative. The same remark applies to that peculiar spotted condition of the throat which has been looked upon with suspicion by some. The inference is very tempting, that a confusion has arisen between the *Meningococcus* and *Micrococcus catarrhalis* in respect to catarrh of the throat.

Another point that is more and more evident on examining the posterior pharynx of a large number of people is the variability in appearance and colour under normal conditions. I hesitate more and more to call a merely red throat an inflamed throat.

The length of time carriers may carry the meningococcus is very variable and often is prolonged. In the case of one of the cerebrospinal fever convalescents (Tm.), positive swabs were obtained for over a month, notwithstanding treatment. We have now still in hospital one of Dr. Claridge's contacts who has been positive to our knowledge for two months. This man is suffering from chronic ear trouble, and it is possible that the Eustachian tube forms a nidus for the organism. Tm. had greatly enlarged tonsils and also adenoids, and these may have been the cause of his persistent carrying of the organism. His tonsils and adenoids were removed and it was thought in subsequent examinations that he was free. An organism, however, which was obtained shortly after the removal and was at first considered to belong to the *flavus* group, on further study has been found to be suspiciously like the meningococcus.

My present opinion on this question is as follows: There is usually a reason for the continued persistence of the organism in the throat, i.e., either connected with enlarged tonsils or adenoids, or with an abnormal condition in one of the many cavities which are connected with the posterior pharynx and nose.

The evidence tends to the view that a person with a normal throat is only a transient carrier of the meningococcus.

As regards treatment, my experience is again small. The method found most satisfactory is nasal douching three times daily with permanganate solution. The solution is poured with a nasal douche right to the back of the nose and returns in considerable quantity through the mouth as well as the nose, thus thoroughly drenching the posterior pharynx. This method un-

[1] These include those who have been in contact with a definite case of cerebrospinal fever, and some who have been examined as "contacts," but who later were found not to have been in contact with a definite case of the disease.

doubtedly temporarily removes the organism from the posterior wall of the pharynx. Sprays and gargles have been found practically useless, the posterior pharynx hardly being touched by them.

Before a case under treatment by douching is examined by swabbing, two days are allowed to elapse so as to allow the organism again to appear if concealed in some accessory sinus.

IV.—Cases of Cerebrospinal Fever.

(1) *Incubation Period.*—The information concerning this which I have been able to collect is extremely vague, and mainly depends on indirect evidence, such as the occurrence of a case in a place previously free in a man who had recently been on leave. The question of the influence of leave on spreading the disease is discussed in Section I (*b*), and for the purpose of discussing the incubation period Table I may again be consulted, in which the period of leave is noted in the last column but one.

In five cases the disease developed within two days of the man's return from leave, the period between the commencement of leave and the onset of disease being three days, four days, five days (twice) and six days respectively. Three of these cases were the first cases of the disease noted among soldiers in the locality, one being at Bishop's Stortford, one at Houghton Regis, and one at Watford. If it is allowed, therefore, that these cases became infected while on leave, the incubation period appears to be a short one. The second case at Houghton Regis also occurred within seven days of the man's arrival at that place, and can almost be grouped with the other five, though a maximum limit is not here to be obtained. The same applies to the case from Saffron Walden. From the first five cases the incubation period would appear to be between three and six days.

The cases which occurred in men actually on leave give less direct evidence, and can be taken in two ways. Three of the men had been home between three and four days when attacked, and one fourteen days. This latter case occurred in a man on leave whose sister was extremely ill, and it is just conceivable that the sister was suffering from cerebrospinal fever and infected the man. I have, however, no information on this point. The matter is so uncertain as to be of no value for the present discussion.

In the case of the other three, however, two occurred within eight days of one another at Littleport in men on leave from different stations, Felixstowe and Bury St. Edmunds. There is

thus here presumptive evidence that the disease was contracted by both after arrival at Littleport, which would again bring down the incubation period to three days or less. As, however, I have no information concerning the occurrence of cases at Bury St. Edmunds and Felixstowe, the argument is not a strong one. The three remaining cases in which return from leave occurred within fourteen days of the onset of disease occurred at Bedford and Peterborough, both places in which some other cases had occurred; they are therefore devoid of value for the present argument.

To sum up, the little evidence available points to a comparatively short incubation period, lying between three and seven days.

Another point may be discussed here: Can a carrier carry the disease in his throat for some time and then under suitable conditions develop the disease? Of this all the evidence I have is in the negative. The number of carriers found in this district has been extremely few, so again my evidence is extremely scanty, but among the few carriers found no illness has ever developed, and catarrh of the throat has been conspicuously absent. Some carriers have been under observation for months, so there is ground for supposing that they are, similarly to diphtheria carriers, practically immune to the disease in the majority of cases.

(2) *Diagnosis.*—Clinically the differential diagnosis of cerebrospinal fever is a matter of considerable difficulty. Not only are the signs and symptoms extremely variable in undoubted cases of the disease, so that hardly any one is constant throughout, but also they are dependent on pathological conditions in the brain and spinal cord, which can be brought about by other infections of these organs beside that of the meningococcus.

In Table VII is given a list of cases, twenty-seven in all, which have been sent in to the First Eastern General Hospital as possible cases of cerebrospinal meningitis, and have ultimately been shown to be of a different nature.

A purulent infection of the brain and cord can be brought about by many organisms, and cases of such infection due to the pneumococcus, streptococcus and staphylococcus have all occurred in this list. The finding of a purulent exudate in spinal fluid removed by lumbar puncture is, therefore, not conclusive of cerebrospinal fever, using this term to designate meningococcus infections only.

Infections by the tubercle bacillus also can be very confusing, as in the later stages of cerebrospinal fever little or no pus may

be found in a puncture fluid, and the amount of fluid obtained may be very similar in the two conditions.

Two cases of this nature have occurred in the First Eastern General Hospital.

The general character of the cerebrospinal fluid obtained by lumbar puncture is therefore no reliable guide to diagnosis.

The matter is different if the bacteriology of the fluid is taken into account, and, as a rule, examination of films, and more especially culture of the fluid is reliable. The diagnosis is only certainly clinched by obtaining a pure culture of the organism, and by subjecting this to tests proving it to be the meningococcus.

In every acute case coming under observation this has ultimately been done, though in some the difficulties of obtaining a culture have been great.

In the majority of cases all the early punctures have grown freely, but in a few, notably those of Wr. and Js. in Table V, only one late puncture fluid has grown, while in the cases of H. and Ty., in Table VI, only the first puncture grew. In four cases the first puncture failed to yield a growth, while in one, that of Y., the third and fourth punctures were the only successful ones. In most cases, therefore, the diagnosis is settled by the successful culture of the organism from the first, and occasionally from the second, puncture.

The medium which has yielded the best results for this purpose has been blood agar, prepared from the fresh aseptically obtained blood of the rabbit. The various media sent out from the Royal Army Medical College, Grosvenor Road, have also usually succeeded, notably a mixture containing peaflour, which was found to be quite successful even without the addition of fresh sterile serum. Legumin agar subsequently supplied was found to be more uncertain and practically useless without the addition of fresh serum.

The routine method of cultivation adopted has been to sow the puncture fluid as soon as possible after it has been obtained on to three or four tubes, distributing the fluid generously over the surface with a loop. The puncture fluid has then been allowed to stand undisturbed from twelve to eighteen hours in the 37° C. incubator, so that any pus present sinks to the bottom. Fresh tubes have then been sown from the sedimented pus. This second sowing has been successful in a certain number of cases in which the first sowing has failed.

In all cases also films have been made both at once and after the incubation of the puncture fluid. Intracellular diplococci have been found in the great majority of cases in which pus has been

present, but often in extremely scanty numbers in the films of the fresh fluid. Their rarity has rendered the application of Gram stain difficult and rather unreliable, and methylene blue has been mainly used. The incubated fluid often shows diplococci in much greater numbers, though they are now no longer intracellular. They are, however, much easier to test by Gram stain.

In our experience the substantiation of Gram-negative diplococci in these films is quite reliable, and has been of very great use in those somewhat infrequent cases in which the earlier puncture fluids could not be grown.

Our routine method has therefore been to examine films, but to wait for the results of culture of the first, or if necessary the second puncture fluid, which have usually been obtained on the first two days, before definitely notifying a case as suffering from cerebrospinal fever. A pure culture of Gram-negative diplococci has then usually been obtained, which has put the case beyond doubt, for all such cultures have ultimately answered the test of the meningococcus. As has been mentioned in Section II, in one case, Tu., a Gram-negative diplococcus was obtained which did not ferment glucose; after some months of cultivation, however, it began to exhibit this power satisfactorily.

In the few cases in which the first two punctures have not grown reliance has been placed on the evidence of films: in these cases the films of incubated fluid have proved especially useful. The cases of Js. and Wr. are examples of the value of this method.

With the amelioration of the patient's condition, the puncture fluid became clearer and clearer, though often remaining at a high or even a higher pressure, and the fluids have ceased to grow or to show diplococci in film. In one case, therefore, which was obtained late in the disease, the puncture fluid proved entirely negative, and, on the whole, the earlier the case was punctured, the easier was the diagnosis. As puncture early in the disease is also of extreme value for the purposes of treatment, its advisability is obvious.

The facility with which most of our puncture fluids have grown is probably partly dependent on being able to sow them and deal with them in a laboratory almost immediately after they were obtained, owing to the collection of all cases into the First Eastern General Hospital as soon as possible.

Three cases only have proved doubtful in our series—the three which occurred in June; in none of these did films reveal any intracellular diplococci, and no cultures could be obtained. These

cases were all comparatively mild, though all gave clinically undoubted signs of meningitis. The course of the disease and the complete recovery which ensued, combined with the actual presence of polymorphonuclear cells in the puncture fluids, gave rise to the final conclusion that these were probably cases of a mild type. In my experience no other purulent affection of the meninges ever recovers. In one of the three (O.) an organism was obtained from the throat identical with the meningococcus.

To sum up: The combined method of examination of films and culture of the puncture fluid enables a diagnosis to be obtained in practically every case in from two to three days, the diagnosis in the majority being clear in one day. This bacteriological method of diagnosis is essential, and the only reliable one.

Cases of purulent meningitis due to other causes can also in the vast majority of cases be diagnosed by the same methods.

In other cases sent in as possible cerebrospinal fever the puncture fluid, when obtained, was always found to be perfectly clear and normal, though it may be noted that in a few of the cases, notably acute influenza and pneumonia, the spinal fluid was found to be under considerably increased pressure. It is possible that some of the cerebral manifestations in these diseases may be directly due to this increased pressure, as distinct relief of such symptoms as intense headache was obtained on its removal by lumbar puncture.

(3) *Specific Treatment.*—The most successful treatment in our hands can be stated shortly. It is immediate and daily lumbar puncture so long as there are no marked signs of clinical improvement. If the improvement commences, but is not maintained, lumbar puncture should again be resorted to.

Table V shows those cases which have recovered. The first seven cases all had illnesses lasting three weeks or under, the shortest period being eleven days in two cases. In all these lumbar puncture was performed daily so long as any clinical indication existed for it, except in the case of Wg., who appears to have been an exceptionally mild case, and was only punctured on the day of admission, the fifth day of his illness. In three out of the first four cases lumbar puncture was done within twenty-four hours of the onset of disease. It is also to be noted that no serum was given in any of these cases. The clinical effect of lumbar puncture is extremely striking, and the patients frequently become extremely desirous for it, as they obtain such relief. In the cases in which serum was injected after removal of the spinal fluid, this clinical relief was markedly absent.

TABLE V.

Recovered. Name	Number of punctures	Days of illness on which L.P.	Mulford serum given	Number grown	Days of illness on which they grew	Length of illness, days	Course of illness
Tm. ..	2	1, 2	..	2	1, 2	11	Uninterrupted recovery.
Rk. ..	**3**	1, 2, 3	..	3	1, 2, 3	11	,, ,,
H. ..	5	4, 5, 6, 7, 8	..	1	4	15	.. ,,
Ty. ..	7	1, 2, 3, 4, 5, 6, 10	..	1	1	15	,, ,,
Wg. ..	1	**5**	..	1	**5**	21	,, ,,
Wd. ..	11	5, 7, 8, 9, 10, 11, 12, 13, 14, 16, 20	..	9	5, 7, 8, 9, 10, 11, 12, 13, 20	22	,, ,,
Yg. ..	10	5, 6, 7, 8, 9, 10, 11, 14, 17, 22	..	5	5, 6, 7, 8, 10	22	Practically uninterrupted recovery.
Wr. ..	6	**3**, 10, 12, 15, 17, 19	**3** (30 c.c.)	1	19	26	Fair recovery.
Tp. ..	6	4, 5, 6, 7, 8, 9	..	6	4, 5, 6, 7, 8, 9	27	Uninterrupted recovery.
Mr. ..	1	**3**	**3**	..	..	28	,, ,, (?)
Bo. ..	5	3, 4, 5, 6, 11	3 (5 c.c.), 4 (15 c.c.), 5 (10 c.c.), 6 (15 c.c.),11(5 c.c.)	2	3, 4	30	Fair recovery.
G. ..	0	..	..	..	..	32	Uninterrupted recovery.
Sw. ..	8	4, 5, 6, 7, 8, 9, 10, 12	..	7	4, 5, 6, 7, 8, 9, 10	36	Fair recovery.
N. ..	4	3, 4, 5, 9	..	3	3, 4, 9	38	,, ,,
St. ..	1	7	..	0	..	41	Moderate recovery (heart).
Ak. ..	12	5, 6, 8, 9, 11, 15, 16, 18, 26, 35, 36, 38	16 (10 c.c.), 18 (15 c.c.), 26 (15 c.c.)	6	6, 8, 11, 15, 16, 18	48	Gradual recovery.
R. ..	2	35, 49	..	1	35	56	,, ,,
Js. ..	17	8, 9, 11, 12, 14, 16, 18, 21, 22, 27, 35, 39, 41, 42, 44, 48, 51	..	1	21	62	Intermittent recovery.
M.* ..	2	43, 60	..	0	0	64	,, ,,
B. ..	2	11, 12	..	1	12	72	Intermittent and prolonged recovery.
Tu. ..	6	3, 9, 48, 67, 74, 77	77 (5 c.c.) of own serum	4	3, 9, 48, 67	86	,, ,, ,,
Rw. ..	32	5, 6, 7, 9, 10, 11, 13, 14, 15, 16, 23, 25, 27, 29, 31, 32, 33, 34, 36, 37, 38, 40, 41, 42, 43, 46, 48, 50, 52, 56, 58, 60	..	22	5, 6, 7, 9, 10, 11, 13, 16, 27, 29, 31, 32, 33, 34, 36, 37, 38, 40, 41, 42, 43, 52	100	Intermittent recovery.
Jh.* ..	12	8, 9, 10, 11, 16, 18, 19, 22, 24, 31, 37, 43	..	6	9, 10, 11, 31, 37, 43	102	Intermittent and prolonged recovery.

* M. and Jh. were readmitted.

Note.—Lumbar punctures performed outside the First General Eastern Hospital by others indicated by black figures.

In the case of Bo., in whom serum was regularly used, the length of the illness does not compare favourably with the cases just quoted.

Another group of cases which recovered lasted from twenty-six to thirty-two days. In three of these, Wr., Mr., and G., as is seen in Table II, admission to the First Eastern General Hospital did not take place till late. In two of them, lumbar puncture had been done elsewhere and serum had been given; in one no serum had been given and no puncture apparently performed; the duration of the illness in this case was thirty-two days. This may perhaps be taken as an indication of the course of recovery of an untreated case.

It may be here remarked that the termination of the illness has been taken throughout to be that day in which all signs and symptoms, such as Kernig's sign and headache, have permanently disappeared, and the temperature has finally come down to normal.

A fourth case in this group is that of Bo., already referred to.

In a third group of cases recovery was gradual but more or less uninterrupted, lasting from thirty-six to fifty-six days. Two of these were obtained only late in their illness, namely St. and R., and in two others lumbar puncture was commenced rather late, namely in the case of Sw. and Ak., and in the remaining case (N.) might well have been continued daily for a longer period than three days.

Finally, a fourth group ran a very prolonged and intermittent course. One of these, again (M.), was only admitted one month after the first onset; one (Tu.), was not punctured daily in the early stage of his illness. In one (Rw.), the first puncture only took place on the fifth day. In two (Js.) and (Jh.), it only took place on the eighth day, and in one (B.) it took place on the eleventh day and was not continued.

In this table the cases in which serum was used do not compare favourably with the rest.

The case of Tu. may be further mentioned. An extremely chronic condition of intermittent headache and other symptoms suddenly came to an end on the administration of 5 c.c. of his own serum. This may have been merely a coincidence, but it was tried as the result of agglutination experiments with the patient's own serum and serum kindly supplied me by Dr. Flexner from New York. The patient's own serum was found to be more highly agglutinating than the Flexner serum, and was therefore tried. This particular case may point to serum, preferably from the patient himself, as being of value in chronic cases.

TABLE VI.—Fatal Cases.

Died. Name	Number of punctures	Days of illness on which L.P.	Mulford serum given	Pus	Number growing	Days of illness on which they grew	Length of illness	Course of illness
Bd. ..	1	2	..	Pus V ..	1	2	36 hours	Fulminant.
Hs. ..	1	1	1 (20 c.c.)	,, V ..	1	1	36 ,,	,,
As. ..	1	3	..	,, V ..	1	3	4 days	Unresponsive.
C. ..	2	3, 4	3, 4 (15 c.c.)	.. V ..	2	3, 4	4 ,,	,,
J. ..	3	3, 4, 5	..	,, V ..	3	3, 4, 5	5 ,,	,,
Dn. ..	3	2, 3, 4	..	.. V ..	3	2, 3, 4	5 ,,	,,
F. ..	2	3, 4	..	,, V ..	2	3, 4	5 ,,	,,
Ht. ..	2	4, 5	..	.. V ..	2	4, 5	5 ,,	,,
My. ..	4	2, 3, 4, 5	3, 4, 5 (15 c.c.)	,, B ..	4	2, 3, 4. 5	5 ,,	,,
Mt. ..	0	0	..	.. V ..	0	0	15 ,,	,,
Ss. ..	9	4, 5, 6, 7, 8, 9, 11, 13, 14	7 (15 c.c.), 14 (6 c.c.)	,, + + + +	9	4, 5, 6, 7, 8, 9, 11, 13, 14	19 ,,	Some response.
An. ..	15	3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18	..	,, + + +	15	3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18	23 ,,	Responded fairly.
A. ..	14	4, 21, 22, 23, 24, 25, 26, 28, 30, 33, 35, 44, 46, 47	..	,, + H	11	4, 21, 22, 23, 24, 25, 26, 28, 30, 33, 34	49 ,,	Responded well; relapse 20th day.
D. ..	30	4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 23, 26, 28, 31, 32, 34, 35, 36, 37, 38, 39, 42, 44, 49	Subcut.: 14, 15, 18 (30 c.c.), 21, 22 (25 c.c.) (B. W. and Co.)	,, — ve. H	16	5, 6, 7, 8, 9, 10, 15, 16, 26, 28, 32, 34, 35, 36, 37, 39	51 ,,	Irregular; slight temporary response; complete occlusion of subarachnoid space in dorsal region
Y. ..	15	6, 9, 11, 13, 40, 43, 44, 46, 47, 48, 49, 50, 51, 54, 56	..	,, — ve. H	2	11, 13	63 ,,	Response very slight.

H = hydrocephalus of third and fourth ventricles.
V = vertex.
B = base.

Turning now to Table VI of cases which died, the first group consists of nine, in which treatment seemed to have no influence at all. Two were fulminant in character, while the other seven all ran a course of four or five days. It may, perhaps, be remarked that none of these seven were punctured on the first day of illness and only two on the second day. It is perhaps unlikely that earlier puncture would have influenced them; as none of them responded at all when they were punctured, it is more probable that the disease here was so severe that no treatment could have influenced it. The post-mortem findings are here of interest. In the greater number the pathological condition was vertical to a marked degree, a most intense congestion of the whole of the meninges being accompanied by a wide distribution of pus scattered all over the vertex in patches. It is difficult to believe that such a severe comprehensive cranial affection could be influenced by any treatment. The next case (Mt.), lasting fifteen days, remained undiagnosed till the post-mortem examination and was never punctured.

TABLE VII.

Disease	Number	Deaths	Suspected C.S.M. cases. *Negative*
Pneumonia	5 ..	1 ..	Dp., Capt. Hn., Pr., *Ps.*, Rs.
Influenza	6 ..	0 ..	E., Ep., Hy., Pe, Rv., Wa.
Tubercular meningitis ..	2 ..	2 ..	*Dt., Pt.*
Pneumococcal meningitis ..	1 ..	1 ..	*Ry.*
Streptococcal meningitis ..	1 ..	1 ..	*Ms.*
Staphylococcal meningitis ..	1 ..	1 ..	*L.*
Subdural abscess	1 ..	1 ..	*J. R. J.*
Acute myelitis	1 ..	0 ..	Hg.
Cerebral embolism	1 ..	0 ..	Bt.
Cerebral tuberculosis ..	1 ..	0 ..	Nh.
Cerebral hæmorrhage ..	1 ..	0 ..	Py.
Delirium tremens	1 ..	0 ..	V.
Convulsive hysteria ..	1 ..	0 ..	Bw.
Neuromimesis	1 ..	0 ..	Ay.
Insanity	1 ..	0 ..	Ms. (Reported by Netley as C.S.M.)
Tonsillitis	1 ..	0 ..	Sw.
Pharyngitis	1 ..	0 ..	Cu.

27 in all, with 7 deaths: { 5 meningitis; 1 subdural abscess; 1 pneumonia } These cases are in italics.

The cases of Ss. and An. are interesting. The pus in the spinal fluid, thick to start with, became increasingly difficult to draw off, till finally, in the case of Ss., only a thin serum could be obtained. Post-mortem, however, it was found that a dense glutinous pus completely filled the thecal space throughout the cord and coated over completely the base of the brain. Here again it is difficult to see what treatment could have been adopted to cause a thinning of this pus.

The last three cases (A., D. and Y.) all showed post mortem a condition of marked dilatation of the central ventricles of the brain, and died with symptoms of excessive pressure on the fourth ventricle.

A. suffered a true relapse, going on well for the first eighteen days of his illness, and then getting all signs and symptoms back in a severe degree, the spinal fluid again being found to be purulent and showing the meningococci freely.

It is possible that more persistent lumbar puncture in the first instance might have averted the relapse.

In the case of D. subcutaneous injections of serum were tried, but were entirely without visible or ultimate effect. Here, again, earlier lumbar puncture might have cut short the illness, the first puncture only taking place on the fourth day. The immediate cause of death was complete occlusion of the subarachnoid space by scarring, so that the later punctures were useless to relieve the hydrocephalus.

Y. was first punctured on the sixth day and next on the ninth, and then subsequently very intermittently till late in his disease. The late punctures all gave a clear fluid at high pressure. He was finally left seven days without puncture, and at the post-mortem a very large amount of fluid at high pressure was found in his third and fourth ventricles.

The pathology of this ventricular dilatation, which markedly affects the central rather than the lateral ventricles, is probably after-scarring in the membranes following on the primary acute infection, and the *rationale* of lumbar puncture is here the prevention of too high a pressure of approximately normal cerebrospinal fluid, in contra-distinction to the reason for puncture in the early stages, which may be compared with draining an abscess. The failure of the first puncture to give a growth in some cases points to the similarity of the condition to that in an abscess—it is only when a flow is established into the cavity that live organisms can be withdrawn.

The evidence obtained is therefore all in favour of early and frequent lumbar puncture, and throws grave doubts on any additional value of antimeningitis serum.

It is perhaps possible to interpret the more favourable results following the introduction of the serum as being really due to increased lumbar puncture, which had to be performed in order to introduce the serum.

COLOUR-BAR: A DIGRESSION IN ETHNOLOGY.

By Colonel R. H. FIRTH.

It will be conceded that, all over the world, the law of custom is slowly breaking down. The influence of steamships and railways is steadily removing the isolation of many races, and alien settlers are intermarrying with many old-time peoples. So great and so cosmopolitan are the forces now at work, that the ethnologist of the future will probably have no pure races left to examine. In fact, it is safe to say that even now no one of the existing peoples is racially pure; we are tempted to go so far as to say that there never has been a pure race since the Mousterian Age; certainly there has been none in Europe during historical times.

We may put the present population of the world at some 1,500 millions, and these we may classify as being 700 millions who are progressive and 800 millions who are stagnant under the law of custom. We cannot say civilized and uncivilized owing to the existence of the London "hooligan," the Parisian "apache" and the New York "Bowery tough." Even the terms progressive and stagnant are inadequate, as witness the Parsi gentleman and the Somerset farm labourer. In the same way, white and coloured are no more satisfactory, for there are Afghans and Chinese many shades whiter than the Portuguese. The problem that will have to be solved by the next generation, and as to which this article aims at directing thought, is, What part is to be taken in the world's affairs by the 800 millions of so-called stagnant or uncivilized men who happen to be pigmentally different to the other 700 millions? The answer is intimately associated with that to another question, Is there any inherent inferiority in their equipment of mind and character? Readers of our daily press will appreciate the presence of this question at our very doors to-day.

The law of custom was the only law known to our forefathers, until the infusion of new blood and new customs forced them to choose between the old and the new, and to make new laws to meet new needs. All this happened so long ago that, if it were not for a few ceremonial survivals, we might well doubt whether our forefathers were ever stagnant. Isolated races will remain stationary for centuries under an ethical code which bids them do as their fathers did before them. In nearly all these cases, custom

is interwoven closely with religion, and is enforced by a fear of punishment in this life. Among patriarchal races, whose gods are their ancestors, this view is strongest, for to depart from the ancestral custom is to insult the tribal god, and it is therefore the business of every member of the tribe to see to it that he suffers no personal harm through the impiety of one of his fellow-tribesmen; so custom holds everyone in its iron hands from the cradle to the grave, and a man cannot move hand or foot without the dread of breaking some *tabu*. It is true, the law of custom has been swept away by conquering races many times in the world's history, but in all these cases, where new customs took root at all, they were implanted by force upon the weaker race by the strong hand of its conquerors, and, as the subject race had obeyed its own custom-law through fear of the unseen, so it adopted the new law through the fear of its new masters. It was a rough but wholesome schooling. Nowadays we go to work in another way; there is little of the conqueror's way about us; we saunter into a country and trade with its inhabitants; we undermine their customs without forcing them to adopt ours; we teach the precepts of Christianity, and in the same breath assure them that, instead of physical punishment by disease which they used to fear when they did wrong, their delinquencies will be visited by eternal punishment after death, a remote contingency which presents no terrors to them; and when the novelty of the idea has worn off they are left, like a rudderless ship, to drift where the wind of fancy drives them. From this point of view, in the coercion of native races the *suaviter in modo* is a more dangerous process than the *fortiter in re*. The fabric of their social system has been built up gradually; we may raze it to its foundations and erect another building in its place, but if we pull out a stone here and there the whole building comes tumbling about our ears before we have time to do any rebuilding.

To some a comforting belief is, that Nature will maintain a balance by operation of a natural law that primitive races begin to decline in numbers as soon as Europeans come into contact with them. A few cases of the kind are on record, but only in respect of islanders, among whom a new disease on introduction has run riot. But we know now that this phenomenon is but temporary and is far from general application. Some continental races have never shown a tendency to decrease, in spite of close contact with Europeans: they seem immune from the ordinary epidemics that have proved so fatal to insular natives. Their capacity for numerical increase would seem to be limited only by the capacity

of their country to support them. Of course, we cannot ignore the fact that as uncivilized people begin to adopt scientific methods of medicine and surgery they will begin to elude the law of the survival of the fittest, but, on the other hand, the more isolated races, who are now the victims of new diseases, will gradually become immune. It is probably safe to predict that the rate of increase of the more virile races will decline as the change in their habits begins to affect them. The European is reckoned to double his numbers in eighty years, the Chinese in sixty, and the African negro in forty years. If this statement be only half true, the outlook for men of European descent is not bright; but, making all allowances, it is obvious that the over-population of the earth is within sight unless some unforeseen agency intervene to prevent it.

We have already premised that no existing people is racially pure, but in spite of this we find nationality and patriotism much in evidence. Possibly both are artificial and really geographical sentiments, yet the whole path of human advance through the centuries is strewn with the corpses of race hatred. Now, the real test by which to gauge race hatred is the test of intermarriage. If two races live side by side for a century or two without any intermarriage, one may conclude that the colour-bar is natural and not an artificial sentiment. Historically, we have little to guide us. Virgil in his eighth Æneid (687 to 688) unhesitatingly condemns the marriage of Antony with Cleopatra, and Horace in his first Ode (37), referring to the relations of Julius Cæsar with the same lady, calls her a "fatale monstrum." Similarly Titus was obliged by public opinion to part with Queen Berenice. In all these cases, and also in the case of Roman soldiers taken prisoner by the Parthians and then marrying native wives, the condemnation was due rather to pride in Roman citizenship and to contempt for barbarians rather than to any colour-bar. Though Juvenal, in his second Satire (23), classes the Ethiopian skin as a physical defect in the same category as bandy legs, one fails to find evidence from the Romans of any colour antipathy having been a bar to intermarriage. This is a very interesting question to us, and much turns upon the question whether race antipathy is inherent, for when two races are brought into contact and competition there is no middle course. Either race antipathy must disappear, or one breed of man must dominate and extinguish the other. Few people have studied race hatred dispassionately, and it calls for calm, cold scrutiny in these times. We meet with it in its acutest form in the United States. In England it is weak and confined

exclusively to those who have lived in the Tropics. In other European countries it is scarcely noticeable. If we look back a bit, we find that race antipathy is a sentiment of modern growth. In the fifteenth and sixteenth centuries, Englishmen do not seem to have thought coloured people their inferiors by reason of their colour. The only race hatred in the Middle Ages was anti-semitic, and this was probably due to the Crusades. Shakespeare saw nothing repulsive in the marriage of Desdemona with a man of colour. The colour-bar seems to have dated only from the slavery period in the West Indies with us, and yet the Romans, Spaniards, Portuguese and Dutch, who were great slave-owners, do not seem to have felt it. These considerations give cause for thought, and, though we do not see clearly the racial future of mankind, certain facts are clear, and one of these is, that a white skin cannot for ever be a kind of patent of nobility. Race prejudice does not die so hard as many think, and when the white man finds himself in a state of political or economic inferiority, he is and will be ready to drop his racial pride and adapt himself to circumstances. It is an unpalatable truth, but a truth all the same.

The real question for the moment is, How far are the backward races fit to compete with Europeans? Someone has said that the average man is incapable of assimilating much more knowledge than his immediate ancestors could acquire, and that the growth of the mind can, in the average man, be but by fractional increments in each generation. There are more exceptions than will prove any such rule. One has only to realize that Brooker Washington and Bughardt Dubois were both full-blooded negroes, or even to look around one in this country or in India. In some physical attributes, such as the sense of smell, the average European falls far below the Malay or Japanese, and a little below the Murray Islander, who excels him in the sense of delicacy of touch and in nice discrimination between small differences of weight. Mental attributes are not open to any scientific test. In making comparisons between the mentality of two races, one must compare the average with the average, and not the average of one race with the exceptional individuals of the other. At most we can say that, so far, there is no evidence to show that any of the backward races have produced individuals equal to Europeans of the first calibre; but we are bound to admit that, among a limited number of individuals of those races, one finds the same aptitude as among the average of Europeans, and that there is, so far as is known, no race of marked mental inferiority, though there may be a larger number of slow

witted individuals in one race than in another. What is lacking, as a rule, in the backward races is character and application. It is strength of character, rather than intellectual power, that achieves big things in this world, and of character we may say it is probably affected by climate and by pressure of circumstances. We must not be rash to assume that character and application are lacking in all individuals of the backward races. Far from it, there are many instances on record. True they are rare, but they are becoming less rare; all around us we see men who are defying the law of custom to their material profit, though not always to their peace of mind perhaps.

As a student of heredity, one can find nothing to encourage the belief that the white and the coloured races will coalesce to produce an intermediate type, but it is a popular error to believe that intermarriage on a large scale would be physically disastrous. The half-caste offspring of such mixed marriages is supposed to inherit the vices of both races and none of the virtues. This is not true, and the idea is based on superficial knowledge of facts and superficial thinking. What little truth there be in the accusation, the social ostracism in which these people are condemned to live would be sufficient, and is sufficient, to account for it. Disowned by their fathers and unrestrained by the customs of their mothers' people, it could scarcely be otherwise. But those who know the Eurasians of India and the half-castes of many races all agree that in aptitude they are equal to the average European, when they have the same education and opportunity. There is, moreover, no physical deterioration in the offspring of half-castes *inter se*. In Java, where the Dutch regard them as social equals, they are eligible for the highest positions in the colony.

Looking at the question from the impartial and critical standpoint, one is forced to conclude that the day is not far distant when, in tropical countries, the line of colour will cease to be the line of social caste. There, as elsewhere, wealth will create a new aristocracy recruited from men of every shade of colour. In this country, in India, and in China the process may be accelerated, for labour unrest and high wages in western lands may compel manufacturers to transfer capital to countries where labour is cheap, plentiful and efficient. The writer of this article knows many men of Hindu and Chinese and Arab origin in London, Manchester, and Liverpool, who control large industries with their wealth. These are no isolated cases, but indices of the time. The day is not far distant when the aristocracy of wealth and of brains will be

composed of every shade of colour. So, too, will be the masses of the workers. In one country the majority of workers will be black or brown, in another, white; but throughout the white man will work shoulder to shoulder with the black and feel no degradation. Logically, why should he, and by stress of evolutionary environment what alternative will he have? It is the picture of no visionary to say that in the near days to come there will be the same feverish pursuit of wealth, the same struggle between capital and labour, but all races will participate in this distribution of wealth. The world, possibly, will then be neither so pleasant nor picturesque to live in as now, but the dominant note will be the curious absence of colour-bar and the evident decay of the law of custom. Few of us are free from prejudices on this colour question, but no thinking man can conceal from himself the need for a saner outlook. To stimulate thought in that direction this article is written, and merits calm reflection by those of us in the Service called to serve in lands other than our own, and often alongside of men racially and pigmentally different from ourselves. Every man is entitled to his own opinion, but let us not be blind to the wider outlook, and be ever mindful that every shield has two sides. Times are changing, and it is for us all to be not only alive to those changes, but also in touch with all arguments and influences which are bringing about these mutations. One writes in no spirit of dogmatism, but rather as the detached observer who sees things too often overlooked by those in the thick of the fight, also as one anxious to warn others of possible troubles ahead, and impressed with the need for an intellectual anticipation of the same.

THE SURGICAL TREATMENT OF WOUNDS ON A BACTERIOLOGICAL BASIS.

By Captain J. O. HAMILTON.

Royal Army Medical Corps.

The bacteriological aspect of this war is one of great importance and interest. Many of our most eminent bacteriologists are studying daily the bacteriology of the wounds under treatment in our hospitals. Many reports have been given and are being prepared, and my apology for bringing before your notice this report is, that by considering all results some definite conclusion will be arrived at. During the last five months I have been stationed at base hospitals in France, and have had an opportunity of treating and investigating the bacterial infection of wounds admitted either directly from the firing line or from our advanced clearing hospitals. The wounds received by us have practically all been infected or septic, and I think all should be regarded as such. The average number of days from the date of the wound being received until it was examined at the base was three days. The number of cases examined bacteriologically was forty-five.

The type of wound selected for examination varied, e.g., superficial — compound fractures of femur and humerus — and deep penetrating flesh wounds. The wounds usually showed an œdema extending some distance from their edges, and in the more severe cases this extended to a very considerable distance above and below the wound.

The bacterial infection of the wounds investigated was invariably a multiple one. The more severe the infection and general toxæmia, the larger the number of organisms isolated. The bacteria fall into two groups:—

(1) Those generally pathogenic for man, e.g., pyogenic cocci and *Bacillus coli*.

(2) Those only very exceptionally pathogenic, e.g., *B. aërogenes capsulatus* and *B. proteus*.

On the average three organisms have been isolated from the forty-five cases investigated. In severe cases, seen early, as many as five have been isolated. This has been observed to occur in cases in which treatment has been delayed or inadequate and in those giving the clinical picture of gas gangrene.

The commonest infecting organism is the *B. aërogenes capsulatus*. It was found in thirty-one of the cases out of the forty-five. The readiness with which it grows varies directly with the amount of necrotic tissue in the lesion. It is thus easily cultivated from untreated wounds or in those which have not been dressed early or frequently. In cases which could be freely exposed to the air *B. aërogenes capsulatus* soon disappeared.

Staphylococci were found as frequently as *B. aërogenes capsulatus*, the white staphylococcus being by far the commoner variety. It was found thirty times in the forty-five cases, the type being that generally known as *Staphylococcus pyogenes albus*. It is a rapid gelatine liquefier and sugar fermenter. It persists in wounds for a considerable time and is often found in pus of chronic suppuration after gunshot wounds, it being the only organism capable of cultivation in some cases. The *S. epidermidis* was also frequently identified, but I have classified both in the table under the heading of "*albus*."

S. pyogenes aureus was found fifteen times in the forty-five cases and conforms in type and reactions to the usual variety. Cases infected by this organism were always severe. In this connection it is of importance to note that in many of the cases in which this organism was found, acute inflammation of the bone developed, tending to spread rapidly, amputation having to be performed.

Streptococci appear as two separate types—an aerobic and an anaerobic; the majority are of the latter type and seem to flourish in the conditions favoured by the *B. aërogenes capsulatus*. In some cases the infection narrows itself down to a purely streptococcal one, and may then become a chronic discharging wound.

Many cases on culture, or even in films of fresh pus, proved to be infected by a Gram-negative bacillus. Twenty-four cases showed an infection of this type. The organism varied considerably: whereas in ten the growth and reactions were typical of *B. coli communis*, in fourteen the growth was very abundant, and so-called "amœboid," spreading rapidly over the surface of the medium and overgrowing every other organism. Sir Almroth Wright gave me the clue that I was dealing with a bacillus of the *proteus* group, and this has proved correct. Considering the habitat of *B. proteus* in soil, its occurrence in these cases is of great interest, but in only one case, a bullet wound of the vertebral column causing further paralegia and death from meningitis, could it be accused of being the causative organism.

Case	*Staphylococcus albus*	*Staphylococcus aureus*	Streptococcus		*Bacillus aerogenes capsulatus*	*Bacillus coli*	*Bacillus proteus*
			aerobic	anaerobic			
1	+	..	+	..	+	..	..
2	+	..	+	..	..	+	..
3	+	..	+	..	+	+	..
4	+	..	+	+	+	+	..
5	..	+	..	+	+	..	..
6	+	..	..	..	..	..	..
7	+	..	+	..	+	..	+
8	..	..	+	..	+	+	..
9	+	..	..	..	+	..	..
10	+	+	..	..	+	+	..
11	..	+	..	+	-	..	+
12	..	..	..	+	+	..	..
13	+	..	..	..	..	+	..
14	+	..	..	+	+	..	+
15	..	+	+	..	..	..	..
16	+	..	..	+	+	..	..
17	+	..	..	+	+	..	..
18	..	+	..	+	+	..	+
19	+	..	..	..	..	..	..
20	+	..	..	+	..	..	+
21	..	+	..	..	+	..	..
22	..	..	..	..	..	..	+
23	..	+	..	..	+	..	..
24	+	..	..	..	+	+	..
25	+	..	..	..	+	..	..
26	+	+	..	..	..	..	..
27	..	+	+	..	+	..	+
28	+	..	..	..	+	..	+
29	+	..	..	..	+	..	..
30	+	..	..	..	..	..	+
31	+	..	..	..	+	+	..
32	+	..	..	+	+	..	..
33	+	..	..	+	+	..	+
34	+	..	..	..	..	..	+
35	..	+	+	..	+	..	..
36	+	+	..	..	+	..	+
37	+	..	..	..	..	+	..
38	..	+	..	+	+	..	..
39	+	+	..	+	+	..	..
40	+	+	+	+	+	..	..
41	..	..	..	..	..	+	..
42	..	..	+	..	..	..	+
43	+	..	..	+	+	..	..
44	+	..	+	..	..	..	+
45	..	+	..	+	+	..	..
Cases 45	30	15	12	16	31	10	14

Another organism identified was a diphtheroid bacillus, which often occurred in large numbers but quickly disappeared from the infection. *B. tetanus* was only once identified, the patient succumbing to the infection. *B. pyogenes* was also twice identified and cultivated in pure growth. From the majority of wounds also, all forms of pathogenic fungi, phycomycetes and mycomycetes were identified, and it was noticed that those wounds which gave the most luxuriant growth of these were fungi by far the most foul in odour.

The treatment of gunshot wounds, which may be regarded as being all septic, must be considered from a bacteriological aspect to get the best results. On examining the table of bacteria identified in the wounds, one is at once struck by the constant occurrence of certain bacteria, and of being able to divide them into two large groups of aerobic and anaerobic bacteria.

The bacteria which belong to the aerobic group, e.g., pyogenic cocci and *B. coli*, are the cause of the majority of septic wounds which one has to deal with in civil practice, but those which fall into the anaerobic group are seldom met with. This group includes the organisms of tetanus and those which produce the severe condition of gas gangrene.

There are numerous gas-producing organisms, but the one most frequently found has been *B. aërogenes capsulatus* of Welch, or *B. perfringens*, as it is named in France. *B. œdematis maligni* is also another allied species. This organism is a spore-bearer, but it is known that other anaerobic bacteria, such as the *B. aërogenes capsulatus*, which do not usually form spores, may do so under conditions unfavourable to them in their bacillary form.

These organisms in their spore or bacillary form are found in soils and dust, especially if these have been contaminated with the excreta of herbivorous animals. It is thus easily conceived how the wounds which have been received after a prolonged trench warfare are contaminated with these anaerobic organisms. The skin and clothes become contaminated with all sorts of pathogenic organisms or their spores, the foreign body carrying them to the farthest point of the wound.

Another way in which a wound may become infected is by the the bursting of a percussion shell in the ground, the small pieces carrying the earth with contained organisms into a wound, which they may inflict. To have, then, infection of a wound contaminated with soil containing anaerobic bacilli or their spores there must be conditions favourable for anaerobic growth.

In considering the class of wound one has to deal with, one

cannot fail to recognize that the above condition is present in a very short time after the wound is received, if not at once.

Generally, the wounds are of the class known as "lacerated," indicating a tearing of the tissues. On examining the wounds after free incision, one is often surprised at the amount of damage to the tissues that has been inflicted by a comparatively small foreign body. Many small pockets are found which pierce far into the surrounding muscular and other tissues. Soon the mouths of these pockets are closed by coagulation of blood and serum, forming an ideal habitat for the anaerobic spore settling there. The spore having been established in an anaerobic condition, develops into its bacillary form. Toxins are soon formed which have a rapid necrosing action, and so a further advance of the anaerobic conditions. The bacilli then advance into the necrosed and anaerobic tissue, fresh tissues surrounding are successively necrosed by the formed toxins, and so a steady advance of the infection proceeds. It has not been definitely decided whether the advancing necrosis is due to the action of the toxins formed by the bacilli or to the action of the by-products formed in the process of the previous tissue necrosis. Sulphuretted hydrogen is one of the gases formed as a by-product, which has a specific action on the red blood corpuscles by combining with the iron of the hæmoglobin.

The common aerobic bacteria will also be present, but the danger from them is of much less moment than the anaerobes. The lacerated condition of the wound also favours their growth, as the tissues are in a state of depressed vitality.

Many of the aerobic organisms of suppuration have a wide distribution in nature, many are present in the skin and mucous membranes of healthy individuals, whilst the *B. coli communis* is a normal habitant of the intestinal tract. It is interesting to note that the *B. coli communis* cultivated from various lesions is more virulent than that in the intestine, the growth in the tissues having increased its virulence.

Treatment.

In treating these wounds, the primary object is to get rid of these organisms by removing the conditions favourable for their growth ; and secondly, to counteract the already absorbed toxins.

(1) *Asepsis.*—All wounds, although they are infected and septic, should be treated aseptically. By that I mean that surgeons, sisters, and orderlies should be as particular as if they were performing an abdominal operation. All instruments should be

sterile and at once sterilized after each case is dressed. No dressing should be applied unless sterile. The area round the wound for a considerable distance above and below should be well washed with spirit soap or ordinary soap and water followed by methylated spirit, and then thoroughly painted with tincture of iodine.

Some surgeons hold the view that much washing and treatment of the surrounding area tends to favour the advance of the sepsis, but I believe that the thorough disinfection of the skin altogether outbalances that view.

(2) *Free Incisions.*—The sooner and the more freely incisions are made, the better is the bacteriological result. The more severe cases are always those which have not a free drainage, either on account of the position of the wound or as a result of the opening becoming closed by a blood-clot, &c. It has also been noted that bad results usually follow where stitches or plugs have been used. The introduction of sutures, even in the largest of wounds, should be absolutely avoided, the introduction of large drainage-tubes being the only treatment admissible. Sir Almroth Wright has previously pointed out the marked bacterial change for the better immediately free drainage is established.

(3) *Antiseptics.*—Antiseptics, to be effective, must be of the most powerful nature. Even then they will only act on the superficial bacteria in the wound and prevent the dressings from forming a suitable nidus for the growth of bacteria in contact with wound. On the other hand, strong antiseptics, e.g., carbolic, cause a coagulation of lymph, leading to the formation of a firm scab, thus closing the wound pockets, and so favouring anaerobic growth.

The treatment of wounds by the method of constant irrigation I have found to give the best results. The antiseptic solution used should be weak, or only saline solution. The continuous application of a weak antiseptic washes away the septic material as soon as it is formed, and also prevents coagulation. In employing constant irrigation, precautions must be taken against wetting of the patient by using suitable macintoshes, or tin vessels in the case of extremities. The nozzle of the tube should lie in the wound and the fluid should not drop from a height, as such dropping causes severe pain in a short time.

(4) *Oxygenation.* -By oxygenation, I mean the free exposure of the wound to oxygen. This can be accomplished by one of the following ways :—

(*a*) The application of *peroxide of hydrogen,* which gives up

its extra atom of oxygen on coming in contact with oxidizable matter. The best method to apply H_2O_2 to a superficial wound is by some form of spray. The fine vapour more easily gets to the recesses of the laceration and there is not so much waste as there is by applying it through a syringe or, which is the same thing, pouring it on from the bottle. I have used with signal success H_2O_2 with an equal part of water applied in a continuous stream.

(*b*) Weak *potassium permanganate* solution applied by continuous irrigation I have found to give excellent results. Potassium permanganate is also an oxidizer.

(*c*) Another method is to leave the wound absolutely exposed to the air. I have had two excellent results by this method of large lacerated wounds of the buttock.

(5) *Iodoform.*—Iodoform I have placed under a separate heading, as I have seen it used so seldom, and also because it is not considered an antiseptic at all by many. Although it does not kill or inhibit the growth of bacteria, it breaks up the products of the bacteria, and in so doing is itself decomposed, iodine being liberated, and then a certain degree of inhibition of bacterial growth occurs from the presence of free iodine. Iodoform, since it is not an antiseptic itself, should be sterilized thoroughly before being applied in the form of a powder. The sweeter smell of the wound is a great comfort to the patient after iodoform is applied, and although some object to its smell, they prefer it to the foul odour they have been accustomed to for a few days.

(6) *Rest.* — Hiton many years ago emphasized the great advantage of rest and comfort. In the treatment of wounds which are lacerated, immobility does give great relief to the patient and also prevents further damage to the tissues and the mechanical spread of organisms along tracts. Even in the smallest of wounds, if it is impracticable to immobilize with splints, rest in bed is of the first importance to their speedy healing and recovery.

(7) *Serum Therapy.*—Lastly, in treating septic wounds, the use of vaccines is, I consider, of great importance. A mixed vaccine of streptococcus with *Staphylococcus albus* and *S. aureus* and *B. coli* acts with great benefit in reducing the septicæmia and remarkably quickly reducing the amount of discharge. Autogenous vaccines give a much quicker and better result; but if this is impossible, the stock vaccine supplied should, I think, be employed in every case.

Sir Almroth Wright has shown some most interesting and

important facts in connection with the action of vaccines on emigration.

Summary.—In summarizing, it is of importance to remember the action of the anaerobic organisms, and to act quickly and thoroughly surgically where signs of gas gangrene are evident. In other words, large incisions, with the use of the sharp spoon, which gives extreme help in opening up and exposing the recesses not opened by the scalpel. Of all antiseptic treatments, I have always had the best results from continuous irrigation with weak antiseptics, H_2O_2 or normal saline. In referring to normal saline, it is of interest to note the increased emigration of polymorphonuclear leucocytes induced by physiological salt solution, as has been reported by Sir Almroth Wright.

A REPORT ON A SERIES OF RELAPSES IN AN EPIDEMIC OF ENTERIC FEVER.

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It is a well-established fact that in the early stages of typhoid fever a septicæmia exists, usually before the fifth day and onwards for a varying period. It is also certain that a second septicæmia exists during the relapse of such fevers. Cummins[1] states that "*B. typhosus* can be isolated from the blood of cases practically constantly at all periods previous to the formation of agglutinins in appreciable quantity, that is to say, up to the seventh day in ordinary cases, until much later in severe cases with retarded production of antibodies, and during relapses where the agglutinins undergo a temporary decrease."

In this connexion the results obtained by blood culture in a series of relapses may be of interest. The cases reported upon are drawn entirely from Belgian civilians and refugees admitted into the Malassise Hospital and include all age-groups of both sexes.

Children (up to and including 14 years) ..	20 per cent.
Men	36 „
Women	43 „

Bacteriological Diagnosis.

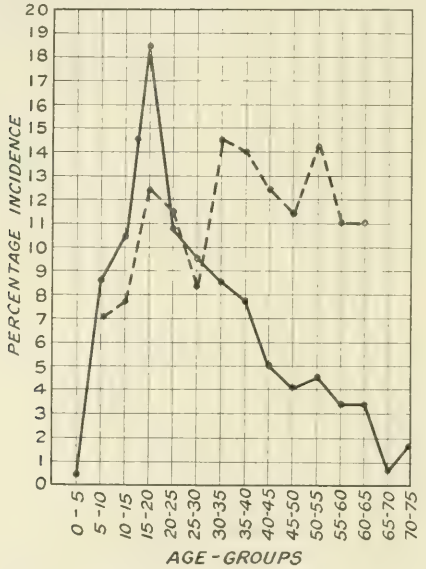
In the 650 cases of enteric fever reported upon, it is desirable to state on what evidence the diagnosis rests. In some 160 cases the bacillus has been recovered either from the blood in the acute stages or during a relapse from the excreta, spots, or post-mortem from the gall-bladder, liver and spleen. While affording no absolute distinction it may be mentioned that the *B. typhosus* was recovered eight times as frequently as *B. paratyphosus* B (142 to 18). The great majority of cases were admitted to this hospital during the later acute stages or completely afebrile, and in these cases, if uninoculated, the bacteriological diagnosis rests on agglutination tests alone; a dilution of 1 in 100 of the serum in *B. typhosus* infections and 1 in 500 in para. B infections being taken as a standard; further, the microscopic method was used. This must

[1] "The Causation and Prevention of Enteric Fever in Military Service," Journal of the Royal Army Medical Corps, June, 1913.

necessarily exclude some convalescent previously inoculated cases, who may have had enteric fever and in whom no additional evidence as to the nature of the illness was forthcoming; the exclusion of this latter group renders the percentage incidence of relapse too high.

Clinical Diagnosis.

The diagnosis of relapse here rests chiefly on the evidence of the temperature chart. Following a period of apyrexia after subsidence of the fever of the acute attack, a bout of continued fever lasting at least six days, the onset of which was either abrupt or "step-like" with or without two other classical signs—namely, enlargement of



——— Proportional incidence of typhoid fever in 650 cases.
- - - - - - Proportional incidence of relapse in each age-group.

the spleen and a roseolar rash—was held to be sufficient evidence of a true relapse. In four cases the afebrile period was short, two to three days, or a gradual waning and waxing of the temperature was observed, i.e., an intercurrent relapse.

Frequency.

In the 650 cases relapse was noted in 78 cases, i.e., 12 per cent. As aforesaid, this percentage is a little too high. One relapse only in 71 cases; two relapses in 7 cases. No case of more than two relapses in the same case occurred.

The chart illustrates the recognized susceptibility to infection in youth and early adult life, the age-group 10 to 25 containing nearly half the total cases. In the age-group 0 to 5, one relapse in a total of three cases. In the age-group 65 to 70, two relapses in a total of four cases. The diminished incidence during the later years of life makes the percentage incidence of relapse during these periods appear abnormally high.

Sex.

As might be expected, no essential difference was noted.

Temperature.

The average duration of the fever of the relapse was fifteen to sixteen days, the longest period being thirty-five days (Case 53); the shortest (blood culture positive) six days (Case 74). The longest period of apyrexia between two relapses was fifty days; in each relapse the blood culture was positive (Case 34). The temperature reached on an average 103° F. (42 out of 77 cases). Higher temperatures, 104° and 105° F., were usually associated with rigors.

Blood Culture.

Out of forty-six cases a positive result was obtained in thirty-seven cases (Eberth's bacillus thirty-five times, para. B twice), i.e., eighty per cent gave a positive culture. The duration of the septicæmia cannot be determined from the figures available.

Case No.	Duration of relapse in days	Day of blood culture
72	32	23rd
70	20	12th
32	18	14th
3	12	10th

Clinical Features.

In recording the cases, an attempt, where possible, has been made to summarize the chief concurrent clinical phenomena of the relapse, e.g., abdominal distension, enlargement of the spleen, roseolar rash. The expression "no notes" implies that none of

Serial No.	Name	Age	Probable duration of illness on admission	Period of apyrexia	Probable week of relapse	Duration of febrile period of relapse in days	Highest temperature recorded. Deg. F.	Blood culture	Organism recovered	Day of relapse on which blood culture was made	Further afebrile period	Clinical features noted during the relapse
1	G. F.	2	3 weeks	5 days	6th	15	104·4	–	..	..	30 days	Stools typical.
2	J. C.	5	..	..	6th	15	100·4	+	Eberth	?	20 ,,	No notes.
3	G. C.	8	6th week	Febrile	6th	12	102·4	+	,,	10th	20 ,,	Spots; spleen palpable.
4	M. C.	9	6th ,,	20 days	9th	8	102·4	+	,,	6th	30 ,,	No notes.
5	M. C.	9	2nd ,,	9 ,,	9th	12	103·8	+	,,	6th	40 ,,	Intermittent pulse; tremors; anorexia.
6	L. V.	10	5th ,,	Febrile	5th	15	103·8	+	,,	5th	50 ,,	Meteorism; no spleen.
7	E. D.	10	3rd ,,	7 days	5th	25	104	+	Neg.	9th	..	Diarrhœa; hæmorrhage.
				20 ,,	12th	14	104	–	..	..	..	Stupor; mania.
8	J. M.	10	2nd ,,	3 ,,	3rd	12	103	–	..	..	40 days	Roseola; no meteorism.
9	J. C.	11	3rd ,,	5 ,,	7th	15	103	+	Neg.	3rd	20 ,,	Cystitis; meteorism; rash doubtful.
10	D. V.	11	7th ,,	21 ,,	8th	16	101	–	..	..	30 ,,	Meteorism; spleen +; roseola.
11	M. C.	12	3—4 weeks	10 ,,	7th	8	102·4	+	Eberth	3rd	..	Roseola. Died miliary tuberculosis.
12	A. B.	12	4th week	14 ,,	6th	7	101·3	+	,,	2nd	30 days	Meteorism.
13	T. R.	12	4th ,,	20 ,,	7th	18	102·8	+	,,	7th	30 ,,	Absence of P.S.
14	A. L.	12	6th ,,	14 ,,	8th	12	104	–	..	..	30 ,,	Roseola.
15	J. S.	12	6th ,,	19 ,,	10th	9	102·8	–	..	..	30 ,,	No notes. T.U.C.
16	A. H.	13	5th ,,	20 ,,	10th	12	102·8	–	..	..	80 ,,	Roseola; T.U.C.; meteorism.
17	J. V.	14	4th ,,	10 ,,	6th	16	103·4	+	Eberth	6th	30 ,,	Headache; abdominal pain; meteorism.
18	G. V.	14	4th ,,	5 ,,	6th	20	102·4	+	,,	7th	50 ,,	Absence of P.S.
19	G. L.	15	3rd ,,	?	10th	10	101·8	–	..	..	35 ,,	No notes.
20	F. L.	16	10th ,,	Febrile	10th	11	103	–	..	..	35 ,,	Absence of P.S.
21	C. F.	16	2nd week	11 days	4th	16	103·2	+	Neg.	14th	30 ,,	Absence of P.S.
22	F. V.	16	4th ,,	I.R.	8th	?	104·2	+	Eberth	6th	..	No splenic enlargement; no rash; P.M. (acute appendicitis; general peritonitis). Died.
23	C. K.	17	6th ,,	10 days	9th	8	101·6	–	..	..	30 days	No notes. T.U.C.
24	A. M.	17	6th ,,	?	7th	16	102·6	–	..	..	35 ,,	No notes.
25	M. D.	17	4th ,,	7 days	5th	17	105	+	Eberth	3rd	30 ,,	Absence of P.S.
26	H. L.	18	7 days	6 ,,	3rd	13	102	+	Neg.	9th	30 ,,	Roseola; nephritis; jaundice.
27	E. S.	18	6th week	3 ,,	7th	15	103 2	+	Eberth	5th	30 ,,	Roseola.
28	C. W.	18	2nd ,,	15 ,,	5th	15	103	+	,,	4th	40 ,,	Absence of P.S.

29	H. D.	19	9th week	6 days	10th	14	104	−	..	..	..	No notes.
				20 ,,	15th	14	104	−	..	..	30 days	Ditto.
30	M. L.	19	4th ,,	5 ,,	5th	11	103·8	−	..	..	30 ,,	Meteorism.
31	A. C.	19	8th ,,	4 ,,	5th	10	103	−	..	..	25 ,,	No notes.
32	G. V.	19	2nd ,,	8 ,,	5th	18	103·6	+	Eberth	14th	..	Absence of P.S.
				20 ,,	11th	14	101·2	−	..	..	20 days	No notes. T.U.C.
33	J. V.	19	4th ,,	5 ,,	5th	22	103·8	+	Eberth	5th	..	No notes.
				8 ,,	9th	15	102	+	,,	5th	20 days	Roseola.
										5th	..	Spleen +.
34	M. B.	20	3rd ,,	12 ,,	6th	22	105	+	,,	5th	..	Meteorism; hæmorrhage; roseola.
				50 ,,	16th	12	103·2	+	,,	4th	25 days	Absence of P.S.
35	M. F.	20	4th ,,	7 ,,	5th	15	104	+	,,	3rd	35 ,,	Absence of P.S.; faucial diphtheria.
36	E. C.	20	3rd ,,	2 ,,	4th	12	103·6	−	..	..	30 ,,	Absence of P.S.
37	M. W.	21	5th ,,	3 ,,	6th	14	102·4	−	..	..	30 ,,	Absence of P.S.
38	M. V.	22	3rd ,,	I.R.	5th	31	103	−	..	..	30 ,,	Absence of P.S.
39	J. D.	23	1st ,,	38 days	7—8	28	103·2	+	Eberth	6th	30 ,,	Spleen +; roseola; meteorism; melæna; diphtheria.
40	G. H.	23	18th day	12 ,,	5th	9	103·8	−	..	..	30 ,,	Roseola; no spleen.
41	J. B.	24	2nd week	6 ,,	4th	7	102·2	−	..	..	30 ,,	No notes.
42	J. D.	25	6th ,,	3 ,,	8th	19	103·4	+	Eberth	4th	40 ,,	No notes.
43	J. Z.	25	3rd ,,	7 ,,	4th	16	103	+	Neg.	15th	30 ,,	Absence of P.S.
44	A. B.	26	6th ,,	Febrile	6th	8	102	−	..	..	30 ,,	No notes.
45	H. V.	29	3rd ,,	30 days	8th	15	102·8	+	Neg.	3rd	..	Spleen +; roseola.
										10th	..	Cholecystitis.
					11th	21	103·8	+	,,	4th	30 days	Spleen +; roseola; thrombosis of femoral vein.
46	A. S.	29	2nd ,,	10 ,,	6th	13	102	−	..	..	25 ,,	No notes.
47	L. V.	30	3rd ,,	4 ,,	5th	16	103	+	Para. B.	4th	(?)	No notes.
48	E. E.	30	(?) 5th ,,	3 ,,	(?) 6th	21	104	−	..	..	30 days	No notes.
49	C. J.	31	6th ,,	8 ,,	8th	15	101·6	−	..	..	40 ,,	Absence of P.S.
50	J. M.	31	3rd ,,	10 ,,	6th	22	104	+	Para. B.	3rd	(?)	Spleen +; roseola; melæna.
51	A. B.	32	9th ,,	10 ,,	11th	22	104	+	Eberth	4th	40 days	Absence of P.S.
52	E. B.	32	2nd ,,	12 ,,	5—6	10	104·8	+	,,	4th	30 ,,	Roseola; meteorism.
53	M. C.	32	Acute	I.R.	(?) 4th	35	104·6	−	..	..	30 ,,	No notes. T.U.C.

ABBREVIATIONS. U.C. = Urinary carrier.
T. = Temporary.
Chr. = Chronic, i.e., still excreting bacilli: three months after defervescence.
P.S. = Physical signs, e.g., roseola; enlargement of spleen; meteorism.
I.R. = Intercurrent relapse.

Serial No.	Name	Age	Probable duration of illness on admission	Period of apyrexia	Probable week of relapse	Duration of febrile period of relapse in days	Highest temperature recorded. Deg. F.	Blood culture	Organism recovered	Day of relapse on which blood culture was made	Further afebrile period	Clinical features noted during the relapse
54	S. L.	33	5th week	8 days	8th	22	103·6	+	Eberth	4th	..	Meteorism.
				7 ,,	12th	15	103	+	Neg.	3rd	30 days	Absence of P.S.
55	F. D.	35	2nd ,,	(?)	7th	15	103	−	..	..	30 ,,	No notes.
56	E. V.	35	4th ,,	9 days	6th	26	103·2	−	..	..	30 ,,	Meteorism; roseola; no splenic enlargement.
57	P. T.	37	2nd ,,	14 ,,	5th	14	102·8	−	..	..	30 ,,	Meteorism; roseola.
58	M. P.	37	3rd ,,	3 ,,	5th	26	103	−	..	..	30 ,,	No notes. T.U.C.
59	I. B.	37	3rd ,,	14 ,,	7th	11	102	−	..	..	70 ,,	No notes.
60	L. C.	38	5th ,,	4 ,,	6th	11	103	−	..	..	35 ,,	Meteorism; diarrhœa.
61	E. W.	38	6th ,,	(?)	6th	9	103	−	..	..	35 ,,	Meteorism.
62	E. B.	40	4th ,,	2 days	5th	30	103·8	+	Eberth	6th	30 ,,	Absence of P.S.; rigors.
63	C. C.	41	3rd ,,	8 ,,	5th	15	102	−	..	..	30 ,,	Absence of P.S.
64	H. E.	42	8th ,,	5 ,,	11th	25	103	+	Eberth	4th	..	Meteorism; P.M. = enteric; died.
65	E. G.	44	3rd ,,	9 ,,	6th	20	101·4	+	,,	4th	?	No notes.
66	H. C.	46	? 4th ,,	12 ,,	? 7 to 8	10	101·4	−	..	..	?	No notes.
67	E. D.	46	2nd ,,	14 ,,	6th	10	103·2	−	..	..	..	Rigor; T.U.C.
68	V. L.	48	3rd ,,	6 ,,	6th	12	103	+	Eberth	4th	30 days	Meteorism.
69	D. V.	50	5th ,,	12 ,,	7th	22	103·6	+	Neg.	7th	40 ,,	Absence of P.S.
										18th	..	Severe bronchitis.
70	O. C.	50	5th ,,	18 ,,	8th	20	103·2	+	Eberth	12th	20 days	No notes.
71	L. B.	50	3rd ,,	4 ,,	7th	32	105	+	,,	23rd	50 ,,	Four rigors; no P.S.
72	J. B.	51	3rd ,,	I. R.	4th	29	103	+	,,	3rd	?	Absence of P.S.
73	P. D.	55	(?)	(?)	10th	10	102·4	−	..	..	40 days	No notes.
74	P. B.	56	3rd week	7 days	6th	6	103	+	Eberth	3rd	25 ,,	Absence of P.S.; T.U.C.
75	L. T.	62	7th ,,	3 ,,	8th	18	103	+	,,	11th	30 ,,	No notes.
76	B. S.	63	4th ,,	12 ,,	9th	9	101·4	−	..	..	60 ,,	No notes; T. U. C.
77	H. M.	67	3rd ,,	12 ,,	6th	15	103·8	−	..	..	70 ,,	No notes; Chr. U. C.
78	E. B.	69	3rd ,,	10 ,,	7th	14	103·2	+	Eberth	5th	30 ,,	No notes.

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I.R. = Intercurrent relapse.

these symptoms have been recorded, but not necessarily their absence. In eleven cases the absence of the above signs is observed in association with a positive blood culture.

	Blood culture		
	Positive	Negative	Not made
With physical signs ..	17	4	9
Absence of physical signs ..	11	5	5
No notes	9	—	24

In two cases the relapse synchronized with faucial diphtheria. In five cases in the whole series a bout of fever resembling a relapse was held to be due to erythema nodosum.

Post-typhoid Elevations of Temperature.

Rises of temperature to 102° or 103° F., lasting two, three, or four days without leading physical signs or symptoms, were noted in sixty cases, or nine per cent. As these "spikes" of temperature closely simulate a relapse at its onset, blood culture was made as often as opportunity presented itself, but in no case with a positive result.

As to the probable mechanism of relapse a tempting hypothesis is put forward by Cummins:[1] "As, however, the body," during an acute attack of typhoid fever, "has now to deal not only with an invasion of bacteria but also with the solution products of their body substance (toxins), it will be necessary to form not only anti-bacterial substances, such as opsonins and agglutinins, but also antitoxic substances. It is conceivable that the production of the latter class of substances may be in excess of that of the former, leading to a clinical recovery from symptoms without a complete elimination of the infective bacteria from the organs."

In conclusion, the evidence for a second septicæmia is clear, eighty per cent in forty-six probable cases; further, in several cases the blood culture had been negative in the subsiding acute stages.

There remains to acknowledge the valuable assistance given by Captain J. A. Ryle in providing and selecting the clinical material of the majority of the male cases, and to Lieutenant A. Stokes for permission to include his results obtained from the majority of the female patients and children.

[1] *Loc. cit.*

Clinical and other Notes.

SOME ILLUSTRATIVE CASES OF THE TREATMENT OF SEPTIC WOUNDS IN A BASE HOSPITAL.

By Lieutenant H. L. MARTYN.
Royal Army Medical Corps.

The problems that have faced the surgeons in the base hospitals in France during the present campaign have been many and varied, and to deal with them successfully departures from the recognized surgical methods have been inevitable. Operative procedures have been adopted which have been the means of saving many a man from fatal septicæmia but which could hardly commend themselves to an examiner in the exact art of operative surgery. The extensive septic infection of almost all wounds and the almost universal infection with the *Bacillus aërogenes capsulatus* have necessitated the freest possible means of cleansing and drainage, and operative methods have had to be adapted to the altered circumstances. Thus it was soon obvious that once emphysematous gangrene was established in a limb and amputation necessary the usual methods of operation with flap-cutting and suturing, even with the freest possible drainage, were useless and almost always resulted in the extension of infection to the stump and death of the patient. The only alternative lay in the recognition of the anaerobic necessities of the infecting organism and a reversion to the primitive direct circular amputation with no attempt to cut a flap, leaving the bone projecting from the stump and the whole freely open to the air; a method with its advantage the saving of the life of the patient, its disadvantage the necessity of a subsequent operation to remove redundant bone and form flaps.

Two cases may be quoted as illustrative:—

(1) Patient admitted May 10, 1915, with a bullet wound four inches below the knee-joint penetrating the leg from before backwards, passing between the tibia and fibula. The leg below the wound was cold, markedly swollen, bluish-black in colour and crepitating on pressure, offensive brownish pus with gas bubbles issued from the wound, and patient was in a condition of marked toxæmia. The limb was amputated immediately above the knee-joint by the direct circular method. The patient passed an uneventful convalescence and showed no signs of infection of the tissues of the stump. The appearance of the stump is shown in the first photograph when granulation was satisfactorily established a fortnight after operation.

(2) An almost identical case to the above, but the infection had not extended to so high a level and amputation was performed at the

knee-joint. The photograph (2) shows the resulting stump with the condyles of the femur projecting from the retracted tissues. The day on which the photograph was taken was three weeks after the original amputation, and on that day re-amputation was undertaken through the skin one inch above the granulating edge. Formal flaps were cut and sewn up with drainage, the operation resulting in a perfect stump uniting by first intention.

CASE 1.—Amputation of leg above knee-joint for gangrene.

CASE 2.—Amputation of leg through knee-joint for gangrene.

No less serious a consideration is the possibility of saving the limb when threatening gangrene is present. Many cases come under observation when well-marked infection with the *B. aërogenes* exists and the question to be decided is whether the life of the patient will be endangered be the effort to save the limb. Undoubtedly the responsibility is great, as if the effort fails in its object subsequent amputation may be too late to save the patient from the early and rapid septicæmia which develops in these cases. The third photograph well illustrates such a question.

The patient was admitted with a bullet wound traversing the leg from side to side three inches above the ankle-joint. The entrance and exit wounds were small and blocked with caked blood. A little offensive brownish pus with gas bubbles escaped from the outer wound on pressure.

The foot was much swollen; over the greater part it was bluish-black in colour, on the dorsum greenish in hue, with the dark veins showing prominently through the skin; marked emphysematous crackling was present on the dorsum of the foot. Round both entrance and exit wounds the skin was absolutely black for a small area, and subcuticular blebs full of blood were present below the inner wound. It was obvious that gangrene of the entire foot was threatening, but inasmuch as the patient's general condition was good an effort was made to save the limb.

Both entry and exit wounds were freely opened up. The fibula was found to be fractured and the back of the tibia grooved; the posterior tibial artery was found divided and ligatured after turning out a large mass of blood-clot.

Case 3.—Bullet wound above ankle-joint: threatened gangrene.

Case 4.—Bullet wound of knee-joint: arthrotomy.

A large drainage-tube was inserted with some "tabloids" of salt, and the wound packed with gauze soaked in peroxide of hydrogen. The foot was then freely incised, all subcutaneous tissue being gelatinous, brownish-black, and containing free gas.

Hydrogen peroxide dressings were employed, and for as long as possible the foot was kept in the open air under only a single layer of gauze.

Within two days the swelling had entirely disappeared and the foot resumed its normal colour, comparatively little sloughing of subcutaneous tissue occurring.

It has been argued that in these cases better results are obtained by incisions transverse to the long axis of the limb, obtaining thereby a greater lymph exudate. This is certainly a point to be considered, but against it must be weighed the fact that the subsequent scarring of a number of transverse incisions cannot but interfere to a considerable extent with the lymphatic and venous return from the limb.

The dressings of greatest value in these cases is also a point for consideration. Much is to be said in favour of Wright's hypertonic saline, but from a considerable practical experience of its use I am still inclined to prefer the free use of peroxide of hydrogen, employed both on dressings and by hypodermic injection combined with prolonged exposure of the wounds to sun and air.

Case 5.—Bullet wound of knee-joint : acute suppurative arthritis : arthrotomy.

Much has been written on the treatment of septic wounds of the knee-joint, and very great judgment must be exercised, especially when the case is complicated by the presence of a retained fragment of metal.

When infection is early and mild and the fragment easily accessible it may be reached by an anterior incision by the side of the patella, and the sepsis effectively dealt with by washing out the joint with saline and subsequent drainage to a similar parallel incision by a drainage-tube behind the patella. Drainage by tubes should be continued for as short

a period as possible, and the wounds allowed to close immediately the effusion subsides. Photograph (4) illustrates such a case.

The patient was admitted with a shrapnel ball lying between the condyles of the femur. There was considerable effusion, but pain was not acute; temperature 102° F., pulse 100. The photograph shows the treatment as suggested above. The shrapnel ball was readily removed through the inner incision. The joint contained blood with some pus but few bacteria; no streptococci were detected.

Drainage was maintained for forty-eight hours by a tube passed behind the patella and the joint irrigated with saline. The photograph was taken three weeks after operation, the joint was then entirely shut off, free movement was possible, and the wounds were granulating. On the other hand, if severe infection is present, especially when the metal fragment is difficult of access, or when it is embedded in one of the condyles, no alternative exists to a complete arthrotomy if the limb is to be saved. Drainage in any other way will be insufficient to deal with infection. An example of such a case is shown in photograph (5).

The patient was admitted having had his left leg amputated above the knee-joint for extensive injury. It was six days since he had been wounded and the right knee-joint was found to contain two fragments of metal, one embedded in the internal condyle. The patient's condition was bad, the joint was distended, acutely tender, and discharging large quantities of pus through one of the wounds; temperature 102° F., pulse 120. Complete arthrotomy was performed by a semilunar incision below the patella dividing the ligamentum patellæ. The crucial ligaments were divided and the cartilages removed. One fragment of shrapnel was found free in the joint and the other removed by a gouge from the substance of the condyle. The interior of the joint was in a condition of acute inflammation and contained pure pus. The leg was put up fully flexed and gradually extended.

The photograph was taken two weeks after the operation with granulation well established. The patient's condition improved immediately after the operation and his temperature fell to normal within four days. Five weeks after the operation the entire surface was covered with healthy granulation tissue and no discharge beyond slight serous exudate. Under the circumstances it was decided to make an attempt at arthrodesis.

The patella was accordingly excised. The granulations which had entirely replaced the cartilage on the articular surface of the tibia were carefully scraped away. A very thin shaving was removed from the femoral condyles and all granulations well scraped off. The limb was brought into a position of full extension and the flap from which the patella had been removed sewn over. Two drainage-tubes were placed behind the bones, one in front and one passing upwards beneath the skin flap. The flap united by first intention, the two anterior tubes were

removed within ten days; within three weeks of operation there remained only the two posterior tubes, from which there was nothing but slight serous discharge. The temperature is steady and there appears no reason why the somewhat, at first appearance, unlikely possibility of primary union should not take place.

Although the method appears ideal from the point of view of ease of dealing with the sepsis if there is extensive bone injury associated with the suppurative arthritis, the infection may be such that amputation is the only alternative, moreover, it has the great disadvantage that a subsequent operation is necessary to ensure a rigid bony union between femur and tibia.

I am indebted to Quartermaster-Sergeant R. C. Blair, R.A.M.C., for his assistance in the preparation of the photographs for publication.

A CANVAS SLING FOR LOADING WOUNDED FROM BARGES AND BOATS INTO HOSPITAL TRANSPORTS.

By Lieutenant-Colonel PERCY HOPE FALKNER.
Royal Army Medical Corps.

The loading of wounded from boats and barges into hospital ships and carriers forms one of the many problems that require very close attention at the present time; and we maintain that it is a matter which should concern the officer in charge, and not be left to chance, or vaguely considered as solely the business of the ship's crew.

The problem may be stated thuswise: A patient, utterly helpless, who requires protection from injury during transfer. He lies upon a stretcher in a boat or barge probably some considerable distance from the ship's deck, and generally hidden from view so far as the man who operates the winch is concerned.

The boat may be a small one—for instance, a stretcher lying thwartships over the after-well of a naval pinnace—and its motion will vary from a condition of steadiness to that of incessant motion according to conditions of weather. Further, the ship herself may be rolling considerably; and yet it is just possible that the patients must be taken on board at all costs.

(1) *Safety.*—A heavy cradle lowered away under unfavourable conditions proves at once unsuitable, and no small handicap to efficient loading.

It is difficult, and sometimes impossible, to land it safely on a small boat; or into a barge the decks of which are covered with stretchers so closely packed that there is little or no room to place the cradle. We have more than once seen narrow escapes notwithstanding every care as regards the winch.

(2) *Speed of Loading.*—The method, as carried out by means of a

wooden cradle, is not sufficiently rapid for average requirements. It may, for the reasons stated, be dangerous to lower away; therefore the process must necessarily be slow. The loading of the patient into the cradle is a clumsy and awkward operation that causes unnecessary delay

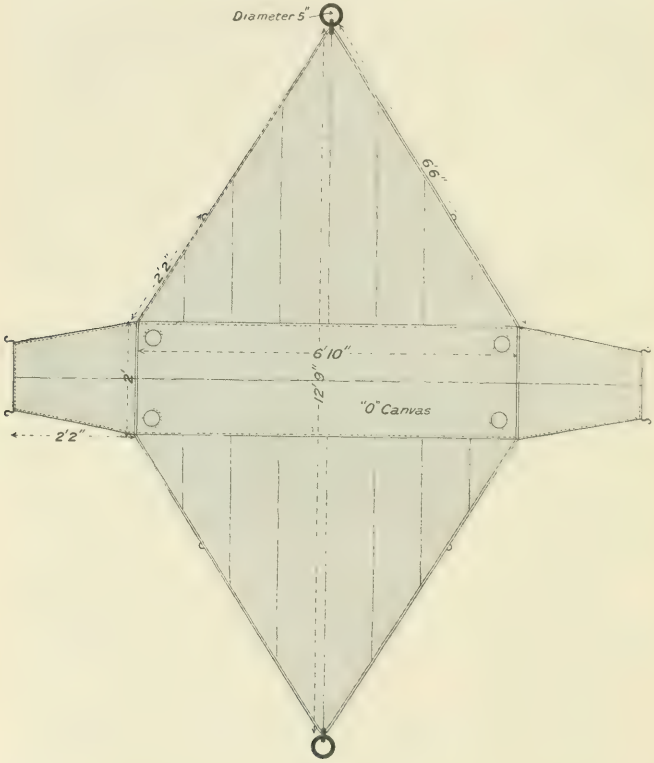


FIG. 1.

of the winch—an important point to remember, as it is usually only feasible to operate one cradle at a time, namely, that on the lee side of the ship.

Some Disadvantages of Loading by means of a Wooden Cradle.

(3) *Labour Wasted.*—The labour of loading and unloading a cradle should be considered for obvious reasons: the staff may be small, and the day a long and arduous one for them.

To try and overcome at least some of these disadvantages a simple canvas sling was devised, and, after practical demonstration, found to exceed the best that was expected from it.

The contrivance is composed of "O" canvas, one inch pliable wire rope, two five-inch iron rings, and four small hooks to secure the end flaps (fig. 1). Wood does not form any part of the sling, and we are satisfied it should not do so.

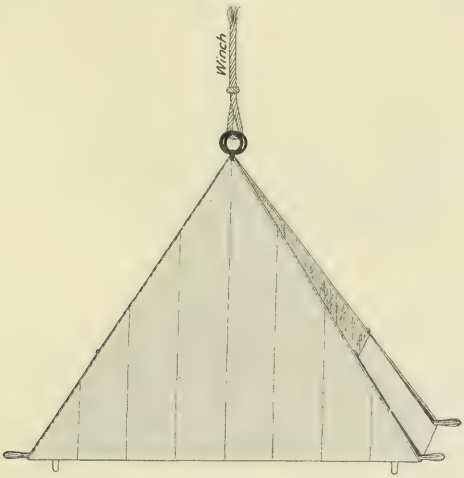


Fig. 2.

The Canvas Loading Sling.

The base measures six feet ten inches by two feet: just sufficient to cover the under surface of the regulation stretcher, and allow its four feet to enter the round holes at each end.

From ring to ring the sling measures twelve feet nine inches, while two feet two inches is a good length for the two end flaps. These flaps are hooked up to four eyelets, located on the edges of the triangular sides, so that they pass between the stretcher handles when the stretcher is in position, and the iron rings are approximated to take the winch hook.

The diagram (fig. 1) illustrates a complete circumference of wire rope for the body of the sling. It should, of course, pass inside a casing of canvas and not be merely sewn to the edges of the cloth; it takes, practically, the whole weight of the stretcher.

Fig. 2 illustrates the stretcher in position, and safe from all risk, provided the winch is operated in a reasonable manner. The inward pressure upon the two stretcher poles is probably no greater now than when the patient is carried by hand; so that the traverses have no tendency to collapse. Should they do so, there is no risk involved.

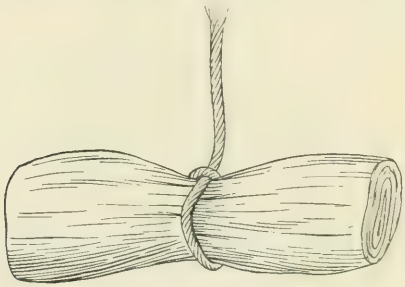


Fig. 3.

Operation.

The first stretcher to come up will probably be the most difficult one to handle, owing to lack of space in the barge. Therefore the sling may be rolled up from one of the peaks to the centre of its floor and passed sideways into position beneath the stretcher after the manner of a "draw sheet." If, on the other hand, it appears more convenient to slip the canvas under from one end of stretcher, roll up the sling crosswise from one flap to the other and place it so that the four feet are taken into the holes provided for them.

No time is lost. One after another the slings are fitted to the stretchers in the boat, while the empty slings coming from the deck above do so as small compact bundles (fig. 3) that cannot injure any one. In practice, and working without great skill or effort, it will take about one minute to land each patient on the ship's deck—more than twice as fast, and with half the labour, as compared to the cradle method.

When the patient reaches the deck (fig. 2), two bearers take the stretcher handles without stooping, while the winch rope is slackened off to unhook the rings. The sling is then rapidly cast off, and falls to the deck while the bearers move forward with their patient.

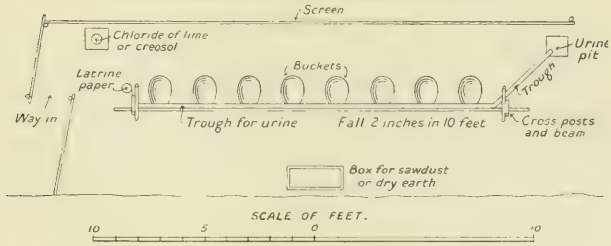
This represents our practice on the Hospital Ship "Salta" at the present time, but modifications as regards the method for operating this sling may suggest themselves in the future.

NEW LATRINE FOR USE IN CAMPS.

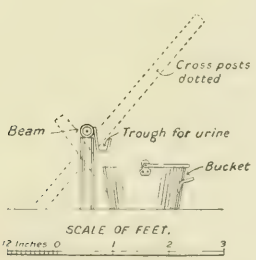
By Lieutenant-Colonel A. D. SHARP.
Royal Army Medical Corps (T.F.).

That incineration is the safest way to deal with excreta in camps is admitted by everybody. Incineration, however, has never been enthusiastically adopted, chiefly because of the unsatisfactory method of keeping the fæces and urine separate. The two receptacle idea, the seat with two

Diagram of latrines for keeping separate urine and fæces.



Plan of latrines.



Detail section through urine trough.

holes, and other devices, so far as my experience goes, had only to be tried to be discarded as unworkable.

I have devised an arrangement which acts automatically and needs no attention. A seat in the form of a stout pole supported on forked uprights

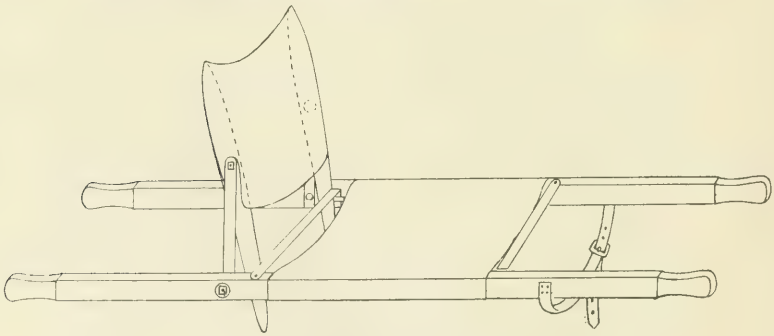
is erected with a fall of two inches in ten feet towards one end. A small trough is made out of biscuit or other tins, and nailed to the posterior surface of the pole. The free edge of the trough, which is rounded, projects about four inches behind, and is about four inches lower than the the upper surface of the pole. The urine trough empties into a pit or receptacle at the lower end towards which there is a fall of two inches in ten feet. The fæces drop dry into the bucket, while the urine is caught in the trough and flows along to the pit or receptacle at the end. The pole seat is rubbed over with paraffin and the trough is flushed down with cresol solution daily. This arrangement has been in use at the 49th (W.R.) Divisional Rest Station for a considerable time and works perfectly. Many other units have copied this method and find that it has solved a long-standing difficulty. The accompanying diagrams require no explanation.

CHAIR STRETCHER.

By Lieutenant J. S. GOODACRE.

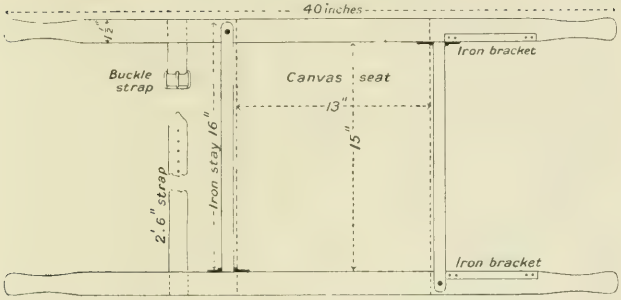
11th Battalion, King's Liverpool Regiment.

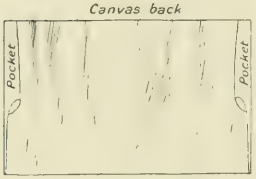
This stretcher was designed to enable wounded to be withdrawn from the firing trenches. Being of short length (only forty inches) it can be carried around any traverse or zig-zag communication trench. By the use of the strap for abdominal cases the knees of the patient can be kept



Rough sketch of stretcher.

pressed into the stomach, enabling these cases to be carried successfully. A broken thigh can be lashed to the handle. It is not intended that the patient should be carried the whole of the way to the dressing station on this stretcher, but only up to the point where the regulation stretcher can come into service.





Pocket on each side to slide over ash bars like rooka chair back.

Designed and constructed by J. S. Goodacre, Lieutenant, 11th Battalion, King's Liverpool Regiment.

Detail of trench stretcher chair: 2 shafts of oak or ash, 40 inches by 1½ inches by 2 inches; 2 stays or spreaders, iron, ⅜ inch by ½ inch by 16 inches, plus 1½ inches right angle bend; 2 iron sockets, ⅜ inch by ¼ inch by 3½ inches; 2 iron brackets of ⅛ inch by ¾ inch by 16 inches, bent to shape; 1 canvas seat, 20 inches by 13 inches; 1 canvas back, 16 inches by 10 inches; 2 ash bars, 14 inches by 1 inch (in centre tapering to ¾ inch at each end) by ⅛ inch; 18 screws; 2 bolts and nuts, 1 inch by ¼ inch; 1 leather strap, 1½ inch by 2 feet 6 inches; 1 leather strap, 1½ inches by 6 inches, with buckle end.

GASTRIC JUICE AND THE PREVENTION OF ENTERIC FEVER AND CHOLERA.

By Lieutenant-Colonel N. FAICHNIE.
Royal Army Medical Corps.

With the commencement of fighting under conditions of temperature such as those at present prevailing in the Dardanelles, I venture to predict that after the usual eight weeks—the so-called eight weeks' phenomenon—there will be a good deal more disease of the enteric group than we have had up to date in France or Belgium.

It is true that our sanitary measures are very complete, but it seems to me that we do not take enough advantage of the power of the gastric juice to act as an antiseptic—a known and admitted fact. Microbial poisons differ from chemical ones in that the former have incubation periods and are much more uncertain in their action, which means, I take it, that the mere swallowing of microbes is of no importance unless they have an opportunity to take root and grow. Let me give as an example an occurrence related in the text-books that has always impressed me very much.

Many years ago, a portion of a cholera stool got mixed up with four gallons of water, and was left to stand in the sun for some hours. Early next morning 19 men each drank an ounce of this mixture, and 5 of them developed cholera; that is to say 14, or 73 per cent escaped entirely, although they must have swallowed enormous numbers of cholera bacilli. It seems probable that in those who escaped, the cholera bacilli, which are well known to be very sensitive to acids, were killed by the hydrochloric acid of the gastric juice.

We may remember that in the Tropics it has long been considered unwise to go out in the morning without eating something first. Also during the fast of Ramazan, when water but no solid food is allowed till sunset, it has been shown that Mahomedans suffer more than Hindus from cholera, although at other times of the year there is no disproportion.

Here, then, we have a principle which seems to be of great importance, viz., that the longer the bacilli of enteric fever and cholera remain in the acid stomach the more likely they are to be killed, and unless they reach the alkaline small intestine alive they can do no harm. The newer physiology teaches us that if water be taken on an empty stomach, it leaves it again almost immediately, also that the clotting of milk in the stomach is a provision of Nature to allow of gastric digestion.

On the other hand, solid food may remain in the stomach for several hours, and leave it slowly, though the observation of bismuth meals shows that the food may begin to move very quickly. Other things being equal, then, it seems probable that the more fluid taken with solid food the more quickly will the latter begin to leave the stomach. As the stomach is said to secrete between eight and ten pints of gastric juice a day (I quote Dr. Alex. Hill), drinking at meals is quite unnecessary.

The following rules, therefore, may safely be laid down:—

(1) For drinking. If the water is above suspicion, or if tea is available, the best time to drink is before meals, in the same way that a horse is watered before being fed. This will supply the body with fluid, and at the same time will leave the stomach comparatively dry for the reception of food.

(2) On the contrary. If the water is not above suspicion never drink it on an empty stomach, as it will pass on almost immediately and penetrate to the small intestine.

(3) If there is nothing but suspicious water to drink, take it in small quantities at a time, and then at least twenty minutes after a meal—the bigger the meal the safer it is to drink—but always drink slowly, so that each small amount taken gets well mixed with the acid of the gastric juice.

As regards eating. Bread issued once in twenty-four hours, and always liable to pollution by dust, or flies, or handling, is, I consider, the most dangerous part of a ration. The drier it is when eaten the longer it will remain in the stomach, and the less diluted will the acid or the gastric juice become. A large drink of even a safe fluid will dilute the gastric juice proportionately, and may also wash down microbes into the small intestines before there has been time for them to be killed.

Just before the War broke out I had arranged to make some experiments in order to try and get bacteriological evidence in favour of these statements, but I was unable to carry them out. As the statements stand, they may be of some value, and considering the good water discipline of some regiments, it should not be difficult to carry out the principle.

MALIGNANT ENDOCARDITIS AS A COMPLICATION OF EPIDEMIC CEREBROSPINAL FEVER.

By Lieutenant W. WRIGHT MACKARELL.

Royal Army Medical Corps.

Amongst the complications of epidemic cerebrospinal fever malignant endocarditis is not mentioned in the current literature, so that the two cases about to be described are apparently unique. They both occurred in the late epidemic and strangely enough were together in the same ward. The one, the first, was diagnosed several weeks before it proved fatal, but the other, for reasons which will be explained later, was not recognized until the post-mortem.

Case 1.—F. W., aged 19, soldier, previously quite healthy, was admitted to hospital on February 20, 1915. He complained of violent headache; he had a foul tongue, Kernig's sign was well marked, there was no rash and no head retraction. His temperature was 99° F., which later went to 101° F.; his pulse was 104. On the following day there was a slight subcuticular hæmorrhagic rash; he was lumbar-punctured and twenty cubic centimetres of Burroughs Wellcome and Co.'s antimeningococcic serum injected into the spinal canal. The fluid drawn off was turbid, and smears showed large numbers of polymorphonuclear leucocytes, and a very few Gram-negative intracellular diplococci, which on culture failed to grow. Following the lumbar puncture the temperature fell to 98° F., the pulse to 66, and the patient felt much better. The following day

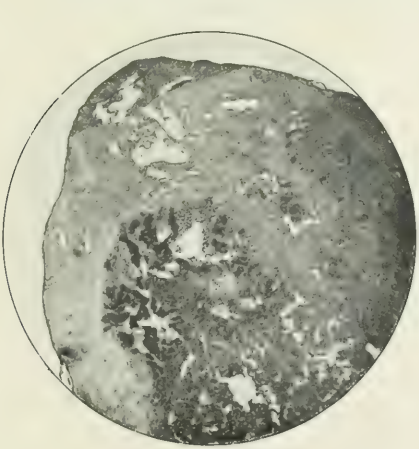
his temperature rose to 102·6° F., the pulse to 116, and the rash became much more marked. His temperature varied between 102° and 98·6° F. for the next three days, and on February 25 ten millions of meningococcic vaccine were injected. (This vaccine was prepared from the organisms from three separate cases, and was tried in several instances with, in some cases, apparently good results.) His temperature fell to 98·8° F., but shortly after rose, and on February 26 he was again lumbar-punctured and serum injected. The fluid was clear and contained only a few polymorphonuclear leucocytes and cultures were sterile. The puncture did not affect his temperature, which continued swinging between 102° F. and normal. On March 1 fifty millions of vaccine was given without result. On March 3 he was again lumbar-punctured, the fluid being quite clear, no polymorphs were present, the fluid reduced Fehling's solution and cultures from it were sterile. On March 9 ten cubic centimetres of blood were taken from the median basilic vein and inoculated into eight tubes of broth. In forty-eight hours there was a copious growth of a Gram-negative coccus which failed to grow below 23° C., fermented glucose but not saccharose. The patient was rapidly losing weight, was very pale, and now for the first time, on examination of the heart, there was a loud presystolic murmur over the mitral area. The diagnosis was then made of malignant endocarditis. A vaccine was prepared from this coccus, which was undoubtedly a meningococcus. The first dose of ten millions was administered on March 16, and was repeated every six days in increasing doses until on April 7 he received 100 millions. At first he seemed to improve after the vaccine, but later he had several rigors, and it was discontinued. He continued to run the same temperature, which was uneven and never now reached normal, and on April 30 and May 5 a vaccine of 500 millions was given without any result. He died on May 18, twelve and a half weeks after the onset.

A post-mortem was performed the same day and showed the following condition: *Brain*, *stomach*, and *intestines* all normal. *Liver* a little congested, 70 ounces; section shows nothing abnormal. *Kidneys*, right 6½ ounces, left 8½ ounces; capsule strips readily; nothing abnormal macroscopially; no infarcts; microscopically a very small amount of acute nephritis. *Spleen*, 35 ounces, full of infarcts; sections show some to be fairly old (two or three months) and others quite recent. *Heart*, 11½ ounces, normal in size; tricuspid orifice admits three fingers; left auricle not dilated; the mitral orifice would only admit a small slate pencil; it was surrounded by friable vegetations which are shown in the accompanying photographs.

Sections of a small piece of the vegetation show very large numbers of a Gram-negative coccus resembling morphologically the meningococcus. The pleomorphism of the organism is well seen in these photographs.

CASE I.

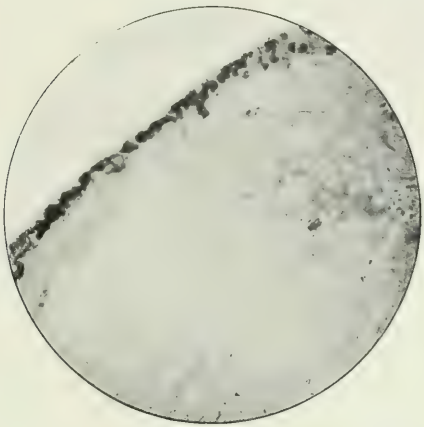
FIG. 1.—Looking down through the left auricle on the mitral valve which is almost completely occluded by vegetations.



CASE I.

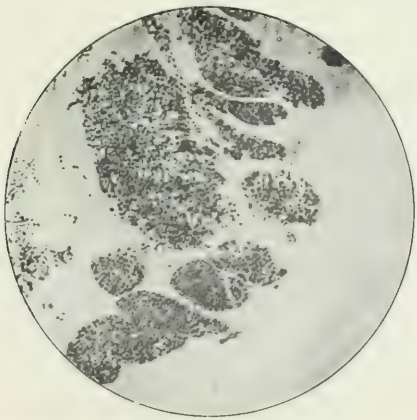
FIG. 2.—Low-power view of piece of vegetation—the black masses are groups of organisms. The small black dots are polymorphonuclear leucocytes.

To illustrate "Malignant Endocarditis as a Complication of Epidemic Cerebro-spinal Fever," by Lieutenant W. WRIGHT MACKARELL, R.A.M.C.



CASE I.

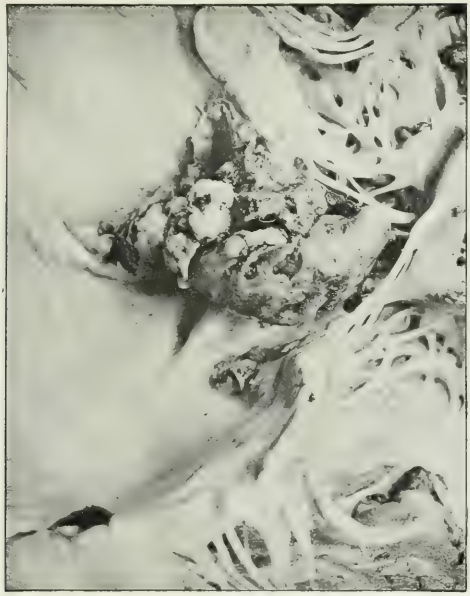
FIG. 3.—Low-power view, showing masses of organisms along the edge of a vegetation.



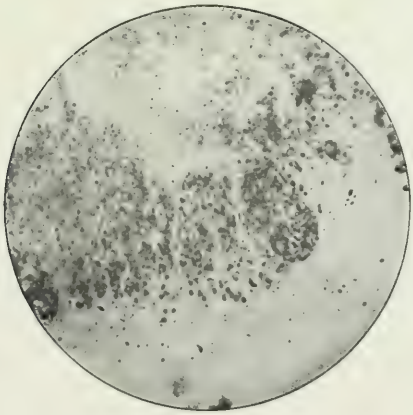
CASE I.

FIG. 4.—High-power view of the dark masses seen in fig. 3. The individual cocci are here shown and the pleomorphism of the organism is well shown.

To illustrate "Malignant Endocarditis as a Complication of Epidemic Cerebro-spinal Fever," by Lieutenant W. WRIGHT MACKARELL, R.A.M.C.



CASE II.
FIG. 5.—Vegetation *in situ*.



CASE II.
FIG. 6.—High-power view of organisms in section.

To illustrate "Malignant Endocarditis as a Complication of Epidemic Cerebro-spinal Fever," by Lieutenant W. WRIGHT MACKARELL, R.A.M.C.

Case 2.—W. M., aged 53, a joiner; he was a fairly well preserved man and well nourished. He was admitted on March 26, 1915, complaining of very severe headache. There was marked head-retraction, Kernig's sign, very marked hæmorrhagic rash all over the body, tongue dry, brown and coated, spleen palpable, temperature 101·4° F., and pulse 100. He was lumbar-punctured the same day and serum (Burroughs Wellcome and Co.'s) injected. The cerebrospinal fluid was very turbid and contained large numbers of intracellular Gram-negative diplococci which grew profusely and proved to be meningococci. He was lumbar-punctured on four occasions, the last time on April 26, and serum was injected. The fluid drawn off was on each occasion very turbid and full of organisms. He was a very difficult patient to manage and would not submit to repeated lumbar puncture. An autogenous vaccine was prepared and administered every four days, beginning on April 30 with 100 millions, and reaching 1,000 millions on May 21, without appreciable benefit. From the onset he had the same remittent temperature as the previous case and died on July 14, almost sixteen weeks after the onset. Malignant endocarditis was thought of, but the condition was presumed to be so extremely rare that it was unlikely that two cases should occur at the same time in the same ward. In addition to its being unlikely, no heart murmur could be heard and there were no rigors. The failure to hear a murmur which must have been present was undoubtedly due to the marked emphysema which made it very difficult to hear the heart sounds. A post-mortem examination was performed thirty-six hours after death and revealed the following condition :—

Marked Emaciation. — *Liver*, 50 ounces, slightly pale, otherwise normal. *Spleen*, 6 ounces, diffluent. *Kidneys*, 5½ ounces each. Capsule laminated. Show chronic interstitial nephritis. *Intestines*, normal. *Stomach*, no distension, normal. *Lungs*, very marked emphysema of both; old healed tubercle in both apices. *Heart*, weight 12 ounces. There was a large vegetation on the mitral valve about the size of the terminal phalanx of the thumb, almost completely occluding the orifice No vegetation elsewhere and no infarcts in any of the organs. *Brain*, there was marked thickening of the meninges. Slight excess of turbid cerebrospinal fluid. There was pus on the upper and posterior surfaces of the cerebellum. The two frontal lobes were stuck together and there was an amount of pus in the great longitudinal fissure in this region.

Photographs are shown of the vegetation *in situ*, also photomicrographs of the organisms, which proved to be Gram-negative diplococci, present in large numbers in sections of the vegetations.

I beg to thank Captain Corfield, R.A.M.C., late M.O.H. of Colchester, and Dr. Fell, at present in charge of the Civil Isolation Hospital, Colchester, for their kindness in allowing me free access to these cases

and their great help afforded me at all times. I also beg to thank Professor E. E. Glynn, of Liverpool University, for his kindness in taking the photomicrographs of the first case.

Current Literature.

An Investigation into the Bacteriology of Dysentery in the Madras Lunatic Asylum (Civil Assistant-Surgeon M. Kesava Pai, M.D. *Indian Journal of Medical Research*, vol. iii, No. 1, July, 1915).—As the dysentery of armies in the field closely resembles the type prevalent in asylums, this paper is of some interest at the present time.

The opening paragraphs of the paper consist of references to other papers treating of the incidence of the bacillary type of the disease both in this country and in India. The summary of these paragraphs is as follows:—

In this country observers have already proved that asylum dysentery is exclusively bacillary in type, and that with the exception of six cases in which the Shiga bacillus was isolated by Eyre, all the others have been found to be due to the mannite-fermenting types. At El Tor in Arabia, Ruffer and Willmore isolated mannite-fermenting types from all cases but one from a large number of pilgrims suffering from the disease.

In India, on the other hand, amœbic dysentery is much more common, and among the bacillary types occurring the Shiga type of bacillus is more common than is the case in this country. In 81 cases of bacillary dysentery investigated by Forster most of the infections were due to the Shiga type, the Y bacillus being the next most common. Of 14 strains isolated by Wells at Hazaribagh Jail, 4 were of the Shiga type, 9 Flexner, and 1 Y bacillus. Of 13 strains isolated by Greig and Wells, 4 were of the Shiga type and 9 Flexner. They observed that in the bacillary cases the organism could only be detected when there was blood or mucus in the stool, and that the excretion of bacilli was sometimes intermittent. All these observers remark on the unreliability of the agglutination test in diagnosis.

The author then describes the work carried out by him on cases in the Madras Lunatic Asylum. Of 136 cases examined for bacillary dysentery from the beginning of 1911 to the end of November, 1914, 54 gave positive results. The Shiga bacillus was responsible for 18 of these, and mannite-fermenting bacilli for 36. Of the 82 negative cases 20 were examined in the diarrhœa stage, and were not passing any mucus or blood. The technique employed in the examination of the stools was as follows:—

"A little mucus from the stools was rinsed in three successive watch-glasses, each containing sterilized normal saline to free it, as far as possible, of the coli organisms normally present in the stool. With a sterilized bent glass rod as spreader, the material was then rubbed well over the surfaces of three MacConkey's plates in succession, without charging the rod a second time. The plates were incubated for twenty-

four hours, at the end of which time the non-acid colonies were sufficiently evident in the midst of the red colonies of the different types of *Bacillus coli* normally present in the fæcal discharge. Though the rule was to find the acid colonies considerably larger in number than the non-acid colonies there were instances when the plates were covered with an almost pure growth of *B. dysenteriæ*. Six to twelve of the dysentery-like non-acid colonies were then planted into a corresponding number of Durham's fermentation tubes containing neutral red, bile-salt, lactose peptone water, from which twenty-four hours later the organism was sub-planted into the different neutral red sugar media used for the classification of strains."

By this method the dysentery bacilli are easily detected in the culture from the blood and mucus, but could not be cultivated from the chronic stage of diarrhœa. Another important consideration was the time elapsing between the passing of the stool and the making of the culture, and also its method of preservation. The sending of the whole stool to the laboratory five miles away was the least satisfactory, many hours elapsing between the passing of the stool and its examination. Subsequently only the mucus was collected from the stool and sent to the laboratory in a test-tube packed in ice. This gave better results, but the best results were obtained by making the plate culture in the asylum itself.

During the course of these experiments the Shiga type of bacillus isolated both in the asylum and from patients in and near Madras invariably only produced acid in glucose and galactose. The Flexner type produced acid in glucose, galactose, maltose, mannite, and indol in sugar-free bouillon with the exception of two strains which failed to produce acid in maltose. The Y type showed a greater variance, especially with regard to their acid-producing powers in raffinose and maltose, while one strain produced acid in dulcite.

A series of agglutination reactions were carried out with the sera of patients at different stages of the attack with their own and other strains of *B. dysenteriæ*. The results obtained were unreliable and by no means characteristic.

Owing to this unreliability, not only as a diagnostic measure, but as a proof of causal relationship, the agglutination reaction of the strong polyvalent serum of the Lister Institute against the different strains isolated by the author was tried. These results were uniformly satisfactory.

All the strains were clumped by this serum in dilutions of 1 in 100 (the macroscopic method being used), and the end-point of some of the strains was as high as 1 in 2,000.

These results were controlled by non-lactose-fermenting organisms isolated from dysentery stools producing gas in glucose, a typhoid-like organism isolated from the urine of a convalescent typhoid patient, strains of *B. coli* from urine and fæces, a non-lactose-fermenting organism from a dysenteric stool, *B. typhosus*, and *B. paratyphosus* A and B. In no case was agglutination complete in a dilution of 1 in 100, and in two cases only, one of *B. coli* from a stool, and one of a non-lactose-fermenter from a dysenteric stool, was it complete in a dilution of 1 in 50.

Relapses have been seen in a number of cases in the asylum, and second attacks in the same patients due to different organisms. Having proved that the asylum cases were mostly bacillary, immunization was

tried, a polyvalent vaccine prepared from all strains isolated in the asylum being used. In 1913 a large number of the inmates of the asylum were inoculated with two doses each (125 and 250 million). The results were not satisfactory and a fresh vaccine consisting of two-thirds Shiga and one-third mannite fermenting strains was tried. The results obtained were no better.

Twenty-six cases were investigated outside the asylum. Of these the Shiga bacillus was recovered from 8, Flexner from 2, and the Y bacillus from 5. Of the 11 negative cases 3 were proved to belong to the amœbic type.

H. G. G.

Correspondence.

NEW WOUND THERAPY.

TO THE EDITOR OF "THE JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—I wish to bring to the notice of R.A.M.C. officers at home and abroad the following treatment for septic wounds:—

Mix equal quantities of pure ichthyol and glycerine, spread on boric lint by means of a camel-hair brush, and apply to the wound. Dress the wound once daily.

If there is also suppuration from a sinus, as in the case of a bullet wound, syringe out with pure sp. vini rectificat; and in this case dressing with gauze is preferable to boric lint. This treatment produces a healthy granulating surface in a few days and does not cause any irritation of the wound.

The daily dressing has a great advantage over fomentations which necessitate frequent changing and disturb the patient, besides prolonging suppuration. The less moisture about a wound the better.

I have almost discarded that barbarity the drainage-tube. The results obtained by this ichthyol treatment are most brilliant.

I am, etc.,

Military Hospital,
The Barracks, Lincoln,

C. W. DUGGAN,
Major, R.A.M.C.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

AUGUST, SEPTEMBER, AND OCTOBER, 1915.

THE King has been graciously pleased to give orders for the appointment of Colonel Michael Thomas Yarr, F.R.C.S.I., to be a Companion of the Order of the Bath, for distinguished service in the Field, dated October 15, 1915. *London Gazette*, October 15, 1915.

War Office,
October 2, 1915.

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned officer, in recognition of his gallantry and devotion to duty in the Field :—

CAPTAIN ERNEST COTTON DEANE, ROYAL ARMY MEDICAL CORPS (ATTACHED 2ND BATTALION, THE LEICESTERSHIRE REGIMENT).

For conspicuous gallantry on August 22, 1915, near Fauquissart. A standing patrol 120 yards in front of our line was bombed by the enemy at about 10 p.m., the only notification being two loud explosions. Captain Deane, without any knowledge of the enemy's strength, at once got over the parapet and ran by himself to the spot under rifle and machine gun fire. Finding four wounded men he returned for stretchers and got them back into safety.

This is not the first time that Captain Deane's gallantry under fire has been brought to notice. *London Gazette*, October 2, 1915.

ARMY MEDICAL SERVICE.

Colonel Herbert J. Barratt, on completion of four years' service in his rank, is retained on the active list, under the provisions of Article 120, Royal Warrant for Pay and Promotion, and to be supernumerary, dated October 2, 1915.

ROYAL ARMY MEDICAL CORPS.

The undermentioned to be temporary Lieutenant-Colonels :—

Dated September 4, 1915.—William Perceval Gore Graham.

Dated September 13, 1915.—Frank Romer ; Herbert Lightfoot Eason, M.D.

The undermentioned to be granted temporary rank whilst employed with the Huddersfield War Hospital :—

As Lieutenant-Colonel :—

Dated September 1, 1915.—William Lawrence Wright Marshall.

Lieutenant-Colonel Henry J. Fletcher is retained on the active list under the provisions of Article 120, Royal Warrant for Pay and Promotion, and to be supernumerary, dated October 7, 1915.

Captain Victor P. Hutchinson is placed on retired pay on account of ill-health, dated October 8, 1915.

Dated July 27, 1915.—Jacob Rosenthal, M.B.

Dated August 4, 1915.—John Robert Lee, M.D., F.R.C.S.Edin.

Dated August 12, 1915.—Graham Colville Ramsay, M.B., from the Indian Medical Service.

Dated August 23, 1915.—William Alfred Costain.

Dated August 26, 1915.—Roderick MacLean; Amos Hubert Coleman, M.B.

Dated August 30, 1915.—William Egon Halinan Beard, M.B.; Matthew Thornton Cassidy, M.B.

Dated September 1, 1915.—Thomas Joseph Buckley, M.B.; Patrick Thomas Tullock Macdonald, M.B.; John George Cronyn; Thomas Davidson Miller, M.B.; John Campbell Boyd, M.D.; John McKie, M.B.; Elliott John Storer; George Cooper, M.D.; William Alexander Stuart, M.B.; Louis Charles Martin; Malcolm Sommerville, M.B.; John Sawers Findley, M.B.; Alexander Scott, M.B.; Percy Collins Litchfield; Ralph Vincent Howell, M.B.; John Watson, M.B.; Ralph Annesley Fuller; James Philip; Edwin George Bleakley Calvert, M.B.; Herbert James Foote, M.B.; James Wyper, M.B.; Peter Sturrock; Christopher Hugh Leete Rixon; John Edgar Taylor; Henry James Thomson, M.B.; William John Shields.

Dated September 2, 1915.—Henry Claude Carter; Lancelot Eric Charles Peckover.

Dated September 3, 1915.—John Lawrence Graham-Jones, M.B.

Dated September 4, 1915.—Henry Pratt Newsholme, M.D.; John Mallock, M.B.; Harold Sugden Vivian, M.B.; John Kerr Morton, M.B.; William Alexander Twigg.

Dated September 5, 1915.—Hugh McLen.

Dated September 6, 1915.—George Marshall, M.B.; Norman Bradley, M.D., William Henry Harris, M.B.; Reginald Leslie Norman.

Dated September 7, 1915.—Frank Lequesne Pelly, M.B.; Hamilton Joseph Bell, Thomas Francis Shackleton; Charles Game Angus Chislett, M.B.; George Francis Oldershaw, M.D.; William Shanks, M.B.; John Norman MacDonald; George Oliver Connell; Francis William Joynes; Frederick John Kirkness, M.B.; Alexander Goodsir Mowat, M.B.; Arthur Alan Miller, M.D.; Harold Percy Crampton, M.D.; Richard Wellington Shegog, M.B.; James Frank Hoare; Alfred Chad Turner Woodward, M.B., F.R.C.S.; William Hamish Donald; Frederick Walton Shilton.

Dated September 8, 1915.—James Leith Hendry; Gilbert William Charsley, M.B.; Wilfred Fairclough, M.B.; William Barbour Thompson, M.B.; Robert Edward Burnet Yelf, M.B.; Thomas Boyd Riddall, M.B.; Frederick Simpson; William Elisha Huff-Hewitt, M.B.; John Robson Dobbin, M.B.; Archibald Gardner, M.B.; John MacKinnon, M.B.; Charles Clouston Irvine; Lionel Matthew Rowlette; Claude Sebastian Van Renan Harwood, M.B.

Dated September 9, 1915.—Charles Roland Babington Eyre; James Denis O'Connor, M.B.; John Donald, M.D.; Archibald Gladstone Naismith, M.B.

Dated September 10, 1915.—Ernest George Fenton, F.R.C.S.I.; Alexander Collingwood Dickson; Richard Leonard Ley, M.B.; Oliver Armand James Needham Muriset, M.D.; Harold Trevor Marrable, M.D.; Thomas Kelly; Samuel Bryson, M.B.; Henry James Flanigan, F.R.C.S.I.; William Wilkinson Uttley, M.B.; Gustavus Herbert Powell; Clare Agustus Everest; Farquhar MacRae, M.B.; Horatio Minchin Hardy; Maurice Davidson, M.D.; Thomas Clifford Last, M.D.; Richard Fox; James MacMurchy Watson.

Dated September 11, 1915.—John Follett Bullar, M.B., F.R.C.S.; Richard Orderne Wilson, M.B.; George Murray Grant, M.B.; Henry Ireland Gascoyne Rutherford, M.B.; Edmond Doherty, M.B.; Edgar Smith.

Dated September 13, 1915.—Charles Satchell Pantin, M.D., F.R.C.S.; William Harris Best; George Errington Lloyd, M.D.; James Macmillan Anderson, M.B.; William Warburton, M.B.; Malcolm Edward Henry Wale; Napoleon Leonard, M.D.; Arthur Turnbull, M.B.; Archibald Stoddart-Walker, M.B.

Dated September 14, 1915.—Clement Massey Stubbs, M.B.; John Bennett Julius Lyttleton Dalby; George Frederick Fawn; Roswell Park, M.D.; William Norman Gilmour, M.D.; Herbert James Pegler.

Dated September 15, 1915.—John Clemence Bawden; John Hope Potter; Alfred Edward Huckett, M.B.; Herbert Malins, M.B., F.R.C.S.Edin.; Cecil Herbert Winter Page, M.D.; Arthur Evelyn Goldie, M.B.; Frederick George Martin; William Core, M.B.; James Harcourt Cecil Gatchell; Edward Thomas Jones; James McKail, M.B.; Frederick Baily Manser, M.B.

Dated September 16, 1915.—Lieutenant James Elvins McCartney, M.B., from The Worcestershire Regiment, Special Reserve; John Cuningham Bell; William Edmund Alexander Buchanan, M.B.; Robert Pettigrew Kennedy; George Atkin Hayman;

Richard John Aherne; Robert Noel Farrer; William Herbertson, M.B.; Andrew James Ferguson, M.B.; John Edward Rees; Eric William Craig, M.B.; Angus Hope Murch, M.B.

Dated September 17, 1915.—Ernest Charles MacKay, M.D.; Malcolm Edward Ball, M.B.; Alfred Stirling Hendrie, M.B.; Allan George Hamilton, M.D., F.R.C.S.Edin.; Philip Gettleson, M.D.

Dated September 18, 1915.—John Joule; Richard James Cane.

Dated September 19, 1915.—William Stanwell; Llewelyn Stanley Howard Glanville, M.D.

Dated September 20, 1915.—Albert Remington Hobbs, M.D.; Percy Rendall, M.D.; Duncan John McAfee, M.D.; Archibald Galbraith Faulds, M.B.; George Coats; Charles Robertson, M.B.; Archibald Grainger Bisset, M.B.; Edgar Giffith Evans; Edward Bromley, M.B; Francis Rupert Snell, M.B.; Ernest Alfred Pywell; Arthur Lerory Robinson; Herbert Augustus Hutt; Charles Berkeley Gervis, M.D.; Alfred Cecil Falkiner, M.B.; Mark Polson, M.B.; Richard Felton, M.D.; Norman McFarlane, M.B.; Meryn Eager; Elijah Brown; Hubert Horace Stones, M.B.; Vicars Maddison Fisher, M.B.; William Millerick; Duncan Fraser Macdonald, M.B.; Robert Anthony Fawcus, M.B.

Dated September 21, 1915.—Samuel Robbins Lane, M.D.; Gerald Lyme Parsons; Frederick Dillon, M.B.; James Alexander Brown, M.D.; Hector Menteith Robertson, M.B.; James Gardner, M.B.; George Frederick Charles.

The undermentioned to be temporary Honorary Lieutenants:—

Dated September 17, 1915.—Geoffrey Challen Linder.

Dated October 1, 1915.—David Hamilton Derry; Temporary Second Lieutenant James Donkin Cockburn, from The Highland Light Infantry.

The undermentioned temporary Honorary Lieutenants to be temporary Lieutenants:—

Dated September 1, 1915.—Joseph Bulmer Thackeray; Arthur Graham Winter; Henry Hugh Mathias; Laurence Mansfield Ingle; James Arthur Liley.

The undermentioned Officers of the Canadian Army Medical Corps to be temporary Lieutenants:—

Dated August 21, 1915.—Captain James Henderson, M.D.; Lieutenant Harry Frederick MacKendrick, M.D.; Lieutenant Jermyn Oscar Baker, M.D.

Dated August 27, 1915.—Captain Cecil Roy Learn, M.D.

Dated September 4, 1915.—Victor George Williams, M.D.

Dated September 5, 1915.—Benjamin Franklin Keillor, M.B.

Robert Harvey to be temporary Quartermaster, with the honorary rank of Lieutenant, dated September 14, 1915.

The undermentioned relinquishes his commission:—

Dated August 20, 1915.—Temporary Major Thomas Kay, M.B.

The undermentioned temporary Lieutenants relinquish their commissions:—

Dated February 11, 1915.—Herbert M. Harrison.

Dated August 30, 1915.—Robert B. T. Stephenson, M.D.

Dated September 1, 1915.—Roy R. Kerr, M.B.

Dated September 2, 1915.—Clifford H. Brookes, M.D.; Richard Bright; William T. Milton, M.D.

Dated September 11, 1915.—John M. Glasse, M.B.

Dated September 14, 1915.—James L. Lawry, M.D.; John E. L. Keyes, M.B.; Maurice Nicoll, M.B.; Vincent Glendinning, F.R.C.S.

Dated September 16, 1915.—George E. Beaumont, M.B.; Patrick Cagney.

Dated September 17, 1915.—Vincent F. Lennane.

Dated September 23, 1915.—Michael J. Hackett, M.B.

Dated September 24, 1915.—Archibald Henderson, M.B.

Dated September 28, 1915.—Peter C. Lornie, M.B.; Arthur G. N. Goldney.

Dated October 7, 1915.—John I. Langley, on account of ill-health; Jerome O'Flynn, M.B., on account of ill-health.

Temporary Major Leslie H. Guest, dated September 30, 1915.

Major G. Horne, relinquishes his temporary honorary commission on ceasing to be employed with the Australian Voluntary Hospital, dated September 30, 1915.

Major T. J. Horder, M.D., relinquishes his temporary honorary commission on ceasing to be employed with No. 7 British Red Cross (Allied Forces Base) Hospital, dated October 7, 1915.

The undermentioned to be temporary Quartermasters, with the honorary rank of Lieutenant:—

Dated July 16, 1915.—David Rose, whilst serving with the Allied Forces Base Hospital.

Dated August 5, 1915.—William Henry Turner.

Dated September 9, 1915.—Francis Henry Atkins.

Dated September 11, 1915.—William Henry Owen.

Dated September 15, 1915.—Arthur Dearsley.

Dated September 16, 1915.—Donald Hector Macdonald, George Drummond.

Dated September 21, 1915.—Richard William Bennett.

Dated September 24, 1915.—William Deans.

Dated September 26, 1915.—William Graham Lawson Fitchett.

Dated September 27, 1915.—Charles Wilson France.

Dated October 1, 1915.—William Singleton, Edward Thomas Smith.

Dated October 4, 1915.—Frank Gaiger.

SPECIAL RESERVE.

Royal Army Medical Corps.

Lieutenant Thomas D. Inch, M.B., to be Captain, with seniority next below C. N. Gover, dated April 1, 1915. (Substituted for the notification which appeared in the *Gazette* of September 9, 1915.)

Lieutenant (on probation) John T. Serogie, M.B., is confirmed in his rank.

William Wallace Blair, M.B., to be Lieutenant (on probation), dated September 9, 1915.

The promotion to the rank of Captain of Lieutenant Ronald W. Duncan is as stated in the *Gazette* of September 9, 1915, and not as notified in the *Gazette* of July 26, 1915.

Lieutenant (on probation) Christopher G. Schurr is confirmed in his rank.

The undermentioned Lieutenants to be Captains:—

Dated September 1, 1915.—John D. MacCormack, Robert H. Williams.

Dated September 17, 1915.—George H. Haines.

Dated September 20, 1915.—Stanley B. King.

Dated September 22, 1915.—John R. Crolius.

Dated September 25, 1915.—Frederick McKibbin, M.B.

Dated September 29, 1915.—Edmund Robinson, M.B.; Arthur C. Bateman.

Captain Samuel Wright resigns his commission on account of ill-health, dated September 19, 1915.

The promotion to the rank of Captain of Lieutenant Richard P. Ballard, M.B.; notified in the *Gazette* of July 23, 1915, bears date April 7, 1915, and not as therein stated.

Second Lieutenant Robert Fowler Walker, M.B., to be Lieutenant (on probation), dated September 1, 1915.

The undermentioned Lieutenants (on probation) are confirmed in their rank: John M. Watt, Robert L. Impey, Peter W. Edwards, Thomas F. Corkhill, Arthur McM. Paterson, Roderic D. Cameron, Walter B. Foley, M.B., Thomas Y. Barkley, M.B., Edwin N. H. Gray, Reginald C. Eades, Raymond Stowers, Alan R. Laurie, M.B., Robert F. Walker, M.B., John W. Malcolm.

TERRITORIAL FORCE.

Royal Army Medical Corps.

London Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains: Thomas W. S. Paterson, dated April 1, 1915; Edward B. Hartnell, dated April 1, 1915; Herbert E. Roaf, dated April 1, 1915; Frederick P. Rankin, M.B., dated April 20, 1915; Ernest G. T. Poynder, dated August 1, 1915. Captain John P. MacLulich, M.D., resigns his commission on account of ill-health, dated October 2, 1915.

2nd London (City of London) General Hospital.—Albert James Walton to be Captain, whose services will be available on mobilization, dated October 3, 1915; Frederick Douglas Selmes Jackson to be Lieutenant, dated October 3, 1915; Leslie Norman Reece to be Lieutenant, dated October 8, 1915.

2nd London Sanitary Company.—Percy Edward Lander to be Lieutenant, dated September 4, 1915; Lieutenant Frederick J. J. Ney to be Captain, dated September 19, 1915; Alexander Middleton Brown, M.B., to be Lieutenant, dated September 21, 1915; James Chalmers, M.B., to be Lieutenant, dated September 21, 1915; Captain Charles A. Spooner, from Attached to Units other than Medical Units, to be Captain, dated October 7, 1915; Robert Hutchison Murray to be Lieutenant, dated October 14, 1915.

4th London General Hospital.—The date of appointment of Lieutenant William K. Churchouse is August 23, 1915, and not as stated in the *London Gazette* of September, 27, 1915.

6th London Field Ambulance.—Lieutenant Frederick L. Golla, M.B., to be Captain, dated April 1, 1915.

2nd Home Counties Field Ambulance.—Major (temporary Lieutenant-Colonel) Antony A. Martin, M.D., relinquishes his temporary rank of Lieutenant-Colonel on alteration in posting, dated September 12, 1915; Major George T. Willan to be temporary Lieutenant-Colonel, dated September 19, 1915; Driver Leighton Maurice Greaves, from 2nd South Midland Mounted Brigade Field Ambulance, to be Transport Officer, with the honorary rank of Lieutenant, dated October 6, 1915.

3rd Home Counties Field Ambulance.—The undermentioned Lieutenants to be Captains: William Cummings, M.B., dated September 5, 1915; John F. Molyneux, M.D., dated September 9, 1915.

Wessex Casualty Clearing Station.—Captain Frank A. Roper, M.B., from 1st Wessex Field Ambulance, to be Captain, dated October 8, 1915; Thomas James Wright to be Lieutenant, dated October 10, 1915.

1st Wessex Field Ambulance.—Captain Richard Eager, M.B., to be temporary Major, dated September 28, 1915; Captain John G. Macindoe, M.B., from 6th Battalion, The Devonshire Regiment, to be Captain, dated September 29, 1915.

3rd Wessex Field Ambulance.—Lieutenant James Kearney to be Captain, dated April 14, 1915; Horace James Pechell, M.B. (late Captain, Territorial Force Reserve, General List), to be Captain, dated October 2, 1915.

East Anglian Divisional Sanitary Section.—The date of appointment of Captain Walter F. Corfield, M.D., is June 11, 1915, and not as stated in the *London Gazette* of June 19, 1915.

1st East Anglian Field Ambulance.—The undermentioned Lieutenants to be Captains: James L. M. Symms, dated April 1, 1915; Harry Whitaker, M.B., dated April 8, 1915; Thomas V. Oldham, M.B., dated April 15, 1915; Laurence H. Hutchins, dated May 14, 1915; Hugh F. G. Hall, M.B., dated July 25, 1915; Ambrose C. Wilson, dated August 11, 1915.

2nd East Anglian Field Ambulance.—The undermentioned Lieutenants to be Captains: Thomas A. Flynn, dated April 1, 1915; Ernest B. Hinde, M.B., F.R.C.S., dated April 1, 1915; Edmund A. Goulden, M.D., dated August 3, 1915; Benjamin B. Morgan, M.D., dated April 1, 1915.

3rd East Anglian Field Ambulance.—The undermentioned Lieutenants to be Captains: William T. Crawford, M.B., dated April 1, 1915; George H. Harper Smith, M.D., dated April 8, 1915; Raymond H. Swindells, M.B., dated May 19, 1915; Edward C. Hobbs, dated June 2, 1915; John N. Robins, dated September 10, 1915; the date of appointment of Lieutenant Frederick C. Kempson, M.B., is September 23, 1914, and not as stated in the *London Gazette* of October 14, 1914; Cadet Roy Dyson Langdale-Kelham, from University of London Contingent, Senior Division, Officers Training Corps, to be Lieutenant, dated October 2, 1915; William Kingdon Legassick to be Lieutenant, dated October 10, 1915.

Notts and Derby Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains: Herbert S. Wallace, M.B., dated April 1, 1915; Douglas J. Marr, M.B., dated April 15, 1915.

South Wales Mounted Brigade Field Ambulance.—Lieutenant Guy S. Thompson, to be Captain, dated April 1, 1915; Lieutenant Herbert M. Pentreath to be Captain, dated April 10, 1915; Norman Frederic Richardson to be Transport Officer, with the honorary rank of Lieutenant, dated August 26, 1915.

1st Welsh Field Ambulance.—The undermentioned Lieutenants to be Captains: Arvor Jones, dated April 1, 1915; Joseph M. Fonseca, dated April 1, 1915; John Clarke, dated April 24, 1915; Vaughan Bateson, dated May 14, 1915.

2nd Welsh Field Ambulance.—The undermentioned Lieutenants to be Captains: John Wallace M.B., dated April 1, 1915; Arthur F. B. Shaw, M.D., dated April 1, 1915; the date of promotion of Lieutenant Charles W. C. Myles, M.B., to Captain, is April 1, 1915, and not as stated in the *London Gazette* of June 8, 1915; Barry K. T. Collins; dated May 23, 1915; Evan D. Richards, dated July 2, 1915.

3rd Welsh Field Ambulance.—The undermentioned Lieutenants to be Captains: Hamilton E. Quick, M.B., F.R.C.S, dated April 1, 1915; Peyton T. Warren, dated April 1, 1915; William Rutherford, M.B., dated April 10, 1915; William J. Richards, F.R.C.S., dated April 18, 1915; George Young, M.B., dated April 19, 1915.

Welsh Casualty Clearing Station.—The undermentioned Lieutenants to be

Captains: Charles Nyhan, dated April 1, 1915; John J. E. Biggs, dated April 20, 1915; The date of appointment of Quartermaster and Honorary Lieutenant Frederic J. L. Gribble is May 27, 9115, and not as stated in the *London Gazette* of July 26, 1915; John H. Robinson, dated June 1, 1915; Major Richard T. Turner, M.D., from Attached to Units other than Medical Units, to be Major, dated July 7, 1915; Lieutenant John H. Robinson, from Attached to Units other than Medical Units, to be Lieutenant, dated October 2, 1915.

1st North Midland Field Ambulance.—Lieutenant John W. Thomson, M.B., to be Captain, dated April 23, 1915; Lieutenant Frank P. Sturm, M.B., to be Captain, dated September 15, 1915.

2nd North Midland Field Ambulance.—Lieutenant Hubert Pinto-Leite to be Captain, dated April 1, 1915.

North Midland Mounted Brigade Field Ambulance.—Lieutenant Fred H. Davies, M.B., to be Captain, dated April 26, 1915.

1st South Midland Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915: Henry E. McCready, M.D.; William Bowater; Morris Wilks, M.B.; Henry P. Thomason, M.B.; Lieutenant William J. Hirst, M.B., to be Captain, dated September 17, 1915; George Henry Hart (late Captain, 1st Volunteer Battalion, Royal Warwickshire Regiment) to be Captain (temporary), dated September 20, 1915.

1st South Midland Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains: William T. Torrance, dated April 1, 1915; Robert W. Aitken, M.B., dated April 1, 1915; Cyril R. Wallace, dated April 1, 1915; Alexander Mitchell, M.B., dated April 3, 1915; William George Rutherford to be Lieutenant, dated September 13, 1915; Samuel Percy Johnson, M.B. (late Surgeon-Lieutenant, 1st Warwickshire Royal Garrison Artillery (Volunteers)), to be Lieutenant, dated October 2, 1915.

2nd South Midland Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915: Ralph A. Broderick, M.B.; William J. C. B. Pitt; Kenneth A. P. R. Murray; Albert E. P. McConnell, M.B.; Staff-Serjeant James Bannerman, from the Edinburgh University Contingent, Senior Division, Officers Training Corps, to be Lieutenant, dated September 9, 1915.

2nd South Midland Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains: Humphrey F. Humphreys, M.B., dated April 1, 1915; George A. Auden, M.D., dated April 1, 1915; William E. H Bull, dated April 15, 1915; Lieutenant Henry J. Blackler, M.B., to be Captain, dated August 10, 1915.

3rd South Midland Field Ambulance.—The undermentioned Lieutenants to be Captains: John P. I. Harty, M.B., dated April 1, 1915; Henry J. D. Smythe, dated April 1, 1915; James G. McLannahan, dated April 1, 1915; Richard I. Dacre, dated May 26, 1915.

South Midland Casualty Clearing Station.—The undermentioned Lieutenants to be Captains: Laurence Ball, M.B., dated May 22, 1915; Henry G. Langdale-Smith, M.B., dated May 27, 1915; Leonard J. Moir, M.B., dated June 4, 1915. Charles William Tressider Baldwin to be Lieutenant, dated October 13, 1915.

1st Eastern General Hospital.—Thomas Shirley Hele, M.D. (late Captain, Unattached List for the Territorial Force) to be Major (temporary) on the permanent personnel, dated August 14, 1915; Ernest Newton Hoffmeister to be Lieutenant, dated October 13, 1915; Geoffrey Alwyn Gershom Bonser to be Lieutenant, dated October 15, 1915.

2nd Eastern General Hospital.—Lieutenant Cyril C. Messiter to be Captain, dated September 3, 1915.

Eastern Mounted Brigade Field Ambulance.—Lieutenant John M. O'Meara, M.B., to be Captain, dated April 10, 1915; Lieutenant James Lamberton, M.B.; to be Captain, dated September 18, 1915.

South Eastern Mounted Brigade Field Ambulance.—Transport Officer and Honorary Captain Lewis H. Coles to be Transport Officer, with the honorary rank of Major, dated March 18, 1915.

2nd Western General Hospital.—Lieutenant Manfred Moritz, M.B., to be Captain, dated June 1, 1915; Lieutenant-Colonel John W. Smith, M.D., from the permanent personnel, to be Lieutenant-Colonel, whose services will be available on mobilization, dated October 2, 1915.

1st Northern General Hospital.—Herbert Wallace Kerrigan, M.B., to be Lieutenant, dated September 1, 1915; Major Frederick C. Pybus, M.B., F.R.C.S., is restored to the Establishment, dated October 7, 1915.

2nd Northern General Hospital.—John William Walker to be Captain, whose services will be available on mobilization, dated August 28, 1915; Captain Alfred H. Horsfall, D.S.O., M.B., to be temporary Major, and seconded for duty with an Ambulance, dated October 10, 1915.

4th Northern General Hospital.—Major William A. Carline, M.D., to be Lieutenant-Colonel, whose services will be available on mobilization, dated October 3, 1915.

1st Southern General Hospital.—Serjeant Major Thomas Samuel Pettitt to be Quartermaster, with the honorary rank of Lieutenant, dated October 12, 1915.

3rd Southern General Hospital.—Robert Hitchings to be Lieutenant, dated September 4, 1915; Samuel Ernest Whitnall, M.B., to be Lieutenant, dated September 14, 1915.

1st East Lancashire Field Ambulance.—The undermentioned Lieutenants to be Captains: Alexander M. Mackay, M.B., dated April 1, 1915; John Morley, M.B., F.R.C.S., dated April 1, 1915; Frederick S. Bedale, dated April 1, 1915; Leonard E. H. R. Barker, M.B., dated June 11, 1915; Gilbert Bailey, dated July 8, 1915; Robert S. Young, M.B., dated July 24, 1915.

2nd East Lancashire Field Ambulance.—The undermentioned Lieutenants to be Captains: Clement A. Webster, dated April 1, 1915; George B. Jameson, dated April 1, 1915; Frederick C. Bentz, M.B., dated April 1, 1915; William Turner, dated May 4, 1915; Alexander M. Gibson, M.B., dated May 4, 1915; William J. Cowan, dated May 26, 1915; John J. Hummel, M.B., dated June 20, 1915.

3rd East Lancashire Field Ambulance.—The undermentioned Lieutenants to be Captains: Arthur M. Johnson, M.D., dated April 1, 1915; Nicholas H. H. Haskins, M.B., dated April 1, 1915; Oliver H. Blacklay, M.D., dated April 1, 1915; Frank G. Prestwich, dated May 5, 1915; James A. Tomb, M.B., dated June 1, 1915; Frederic B. Smith, dated June 7, 1915; Henry Wilson, M.B., dated June 24, 1915.

1st West Lancashire Field Ambulance.—The undermentioned Lieutenants to be Captains: James Walker, M.B., dated April 1, 1915; Samuel McCausland, dated April 1, 1915; Thomas Courtenay Clarke, M.B., dated April 1, 1915; Harold Seddon, M.B., dated April 1, 1915; William Evans Graham, M.B., dated April 22, 1915; Frederick Ryan, M.B., dated June 14, 1915.

2nd West Lancashire Field Ambulance.—Lieutenant Robert G. Wills, M.B., to be Captain, dated April 1, 1915.

3rd West Lancashire Field Ambulance.—Lieutenant Sandys J. C. Holden, M.B., to be Captain, dated June 15, 1915.

2nd West Riding Field Ambulance.—Lieutenant Wallace W. Adamson, M.B., to be Captain, dated April 10, 1915.

3rd West Riding Field Ambulance.—Captain George E. St. C. Stockwell, M.B. 7th Battalion, West Yorkshire Regiment, to be Captain (temporary), dated September 9, 1915.

2nd Northumbrian Field Ambulance.—Lieutenant James G. Hill, M.B., to be Captain, dated September 24, 1915.

3rd Northumbrian Field Ambulance.—Transport Officer and Honorary Lieutenant John Riley is seconded, dated September 29, 1915.

Northumbrian Casualty Clearing Station.—The undermentioned Lieutenants to be Captains: Robert W. Smith, M.B., dated September 12, 1915; Frederick S. Walker, M.D., dated September 16, 1915.

1st Lowland Field Ambulance.—The undermentioned Lieutenants to be Captains: Arthur D. Downes, M.B., dated April 1, 1915; William C. Gunn, M.B., dated April 1, 1915; Robert S. Taylor, M.B., dated April 1, 1915; Arthur W. Sutherland, M.B., dated April 29, 1915; George B. Eadie, M.D., dated, April 29, 1915; Percival J. Moir, M.B., dated April 29, 1915. Robert Watson, to be Lieutenant, dated August 10, 1915.

2nd Lowland Field Ambulance.—The undermentioned Lieutenants to be Captains: William H. Manson, M.D., dated April 1, 1915; James W. Burton, M.B., dated April 12, 1915. William Combe, M.B., to be Lieutenant, dated September 15, 1915.

3rd Lowland Field Ambulance.—The undermentioned Lieutenants to be Captains: Andrew J. Brown, dated April 1, 1915; William W. Greer, M.D., F.R.C.S.Edin., dated April 1, 1915; Rankine G. Walker, M.B., dated April 1, 1915; Arthur J. G. Hunter, M.D., F.R.C.S.Edin., dated April 1, 1915; Archibald M. Stewart, M.B., dated April 1, 1915; Clifford H. K. Smith, M.B., dated May 1, 1915. The following announcement is substituted for that which appeared in the *London Gazette* of August 17, 1915: James Wilfred George Hewat Riddel (late Second Lieutenant, 1st Lowland Brigade, Royal Field Artillery), to be Lieutenant, dated July 21, 1915;

Quartermaster-Serjeant Thomas James Carbarns, to be Quartermaster, with the honorary rank of Lieutenant, dated October 5, 1915.

1*st Highland Field Ambulance.*—The undermentioned Lieutenants to be Captains: James A. Morris, M.B., dated April 1, 1915; James E. G. Thomson, M.B., dated April 1, 1915; Daniel M. Grant, M.B., dated April 8, 1915; James S. McConnachie, M.B., dated April 8, 1915; Charles A. Whyte, dated April 15, 1915; George Davidson, M.D., dated April 16, 1915; Bernard G. Beveridge, M.B., dated May 21, 1915. Thomas Priest to be Qurrtermaster, with the honorary rank of Lieutenant, dated October 5, 1915.

2*nd Highland Field Ambulance.*—The undermentioned Lieutenants to be Captains: Alexander C. Mallace, M.B., dated April 1, 1915; George Henderson, dated April 1, 1915; Hawtrey W. Browne, M.B., dated April 1, 1915; George S. Melvin, M.B., dated April 20, 1915; Robert T. Bruce, M.D., dated May 13, 1915. The date of appointment of Lieutenant Alexander Main Baillie, M.B., is July 29, 1915, and not as stated in the *London Gazette* of September 3, 1915. The date of appointment of Lieutenant Harry Gordon Donald, M.B., is July 30, 1915, and not as stated in the *London Gazette* of September 3, 1915. The date of appointment of Lieutenant John William McKeggie, M.B., is July 31, 1915, and not as stated in the *London Gazette* of September 3, 1915. The date of appointment of Lieutenant James Alexander Sellar, M.B., is August 7, 1915, and not as stated in the *London Gazette* of September 3, 1915.

3*rd Highland Field Ambulance.*—The undermentioned Lieutenants to be Captains, dated April 1, 1915: John Strathearn, M.D., F.R.C.S.Edin., George B. Killoh, M.B.; John M. Milne, dated April 15, 1915; George McConnell, M.B., dated May 4, 1915; Thomas C. Britton, M.B., dated May 4, 1915.

Highland Mounted Brigade Field Ambulance.—Major John W. Mackenzie, M.D., to be temporary Lieutenant-Colonel, dated September 7, 1915; Captain Lachlan M. V. Mitchell, M.B., to be temporary Major, dated September 7, 1915.

Scottish Horse Mounted Brigade Field Ambulance.—Lieutenant Frederick G. Harper, M.D., to be Captain, dated September 1, 1915.

1*st Scottish General Hospital.*—Lieutenant Ian G. Bisset, M.B., to be Captain, dated September 8, 1915.

2*nd Scottish General Hospital.*—The date of appointment of Lieutenant John Watson Simpson, M.B., is July 9, 1915, and not as stated in the *London Gazette* of August 14, 1915.

Sanitary Service.

The following announcement is substituted for that which appeared in the *London Gazette* of December 22, 1914:—

Captain Herbert E. Corbin, from attached to Units other than Medical Units, to be Captain, and appointed Sanitary Officer, East Lancashire Division, dated September 28, 1914.

The undermentioned Captains to be Majors, dated October 10, 1915:—

Davy T. Belding.
David Rennet, M.D.
Robert A. Dunn, M.D.
John Murray, M.B.
William B. Barclay.
William Butler, M.B.
Arthur M. N. Pringle, M.B.
Marcus G. Yunge-Bateman.
Harold Scurfield, M.D.
Duncan Forbes, M.D.

Attached to Units other than Medical Units.

The undermentioned Lieutenants to be Captains:—

Alexander S. M. Macgregor, M.D., dated April 1, 1915.
William T. Gardiner, M.B., F.R.C.S.Edin., dated April 1, 1915.
Edmund F. Rose, dated April 1, 1915.
John A. Parsons, M.D., dated April 1, 1915.
Charles M. Mitchell, dated April 1, 1915.
Herbert V. Capon, dated April 1, 1915.
Gerald L. Bunting, M.D., dated April 1, 1915.
Duncan F. Macrae, M.B., dated April 1, 1915.

Thomas Carnwath, M.B., dated April 1, 1915.
Charles W. Wirgman, M.D., F.R.C.S., dated April 1, 1915.
Alfred N. Crawford, F.R.C.S.I., dated April 1, 1915.
John Livingston, F.R.C.S.Edin., dated April 1, 1915.
John F. Edmiston, M.B., dated April 1, 1915.
Arthur H Faulkner, dated April 1, 1915.
Robert A. Kerr, M.B., dated April 1, 1915.
Kenneth D. Wilkinson, M.B., dated April 1, 1915.
Arnold Morris, dated April 1, 1915.
Francis H. Sprague, dated April 1, 1915.
Douglas E. Finlay, M.B., dated April 1, 1915.
Duncan Davidson, M.B., dated April 1, 1915.
George F. R. Smith, M.B., dated April 1, 1915.
William George, M.B., dated April 1, 1915.
Archibald Cambell, dated April 1, 1915.
Frank Clayton, M.D., dated April 1, 1915.
Oswald L. Scarborough, dated April 1, 1915.
Alexander K. Maclachlan, M.B., dated April 1, 1915.
James G. Hayes, dated April 1, 1915.
Charles F. Searle, M.B., dated April 1, 1915.
Frederick C. Kempson, M.B., dated April 1, 1915.
William S. McCune, M.B., dated April 1, 1915.
George J. M. Martin, dated April 1, 1915.
Arthur E. Bullock, M.B., dated April 1, 1915.
Alastair R. Grant, M.B., dated April 1, 1915.
John Morris, M.B., F.R.C.S., dated April 1, 1915.
Theophilus W. Morcom-Harneis, dated April 1, 1915.
Walter R. Bristow, M.B., F.R.C.S., dated April 1, 1915.
Leonard B. Baird, dated April 1, 1915.
George B. Pearson, dated April 1, 1915.
Grahame Patton, dated April 1, 1915.
William J. Phillips, M.B., dated April 1, 1915.
Leonard West, M.B., dated April 1, 1915.
William J. H. Davis, dated April 1, 1915.
William L. Burgess, M.D., dated April 3, 1915.
William E. Fitzgerald, M.B., dated April 6, 1915.
Andrew P. Granger, M.B., dated April 12, 1915.
Pierce N. Creagh, dated April 15, 1915.
James G. F. Hosken, dated April 15, 1915.
Alfred H. T. Andrew, M.B., dated April 24, 1915.
Sidney H. Clarke, M.D., dated April 24, 1915.
John G. Morgan, dated April 28, 1915.
Gordon Whitehead, M.B., dated May 3, 1915.
Arthur J. Friedlander, dated May 3, 1915.
George D. Thomson, dated May 5, 1915.
Robert G. McD. Ladell, M.B., dated May 7, 1915.
John K. Syms, dated May 9, 1915.
Robert D. Cran, dated May 11, 1915.
George R. E. G. Mackay, M.B., dated May 14, 1915.
Charles G. Tench, M.B., dated May 14, 1915.
George Crawshaw, M.B., dated May 23, 1915.
Rowland L. Thomas, dated May 26, 1915.
Ralph A. Burditt, dated June 4, 1915.
Thomas J. Thomson, M.D., dated June 7, 1915.
Percy H. Burton, dated June 15, 1915.
Lancelot W. Sparrow, M.B., dated June 18, 1915.
Ashley S. Hopper, M.B., dated June 30, 1915.
Michael Brannan, M.B., dated July 1, 1915.
Gerald A. Child, dated July 5, 1915.
Leslie E. Hughes, dated July 12, 1915.
Hugh A. Sandiford, M.B., dated July 15, 1915.
William A. Phillipps, M.D., dated July 18, 1915.
Henry F. J. Graves, dated August 8, 1915.
Ernest Osborne, dated August 18, 1915.

Berkeley N. Ash, dated August 26, 1915.
John R. B. Russell, M.B., dated August 28, 1915.
Francis Field Cunningham Jagger, M.B., to be Lieutenant, dated August 28, 1915.
Joseph L. Baskin, dated September 2, 1915.
Herbert Smith to be Lieutenant, dated September 2, 1915.
Frank Jeffree, M.D., dated September 3, 1915.
Archibald Jubb, M.D., dated September 5, 1915.
James M. Heron, M.D., dated September 18, 1915.
Donald Grant Dingwall to be Lieutenant, dated September 20, 1915.
Reginald D. Moore, dated September 22, 1915.
Wilfred Winnall Horton, M.D., to be Lieutenant, dated September 24, 1915.
Albert Edward Evans, M.B., to be Lieutenant, dated October 15, 1915.

TERRITORIAL FORCE NURSING SERVICE.

Miss Sarah Jane Cockrell to be Matron, 4th London General Hospital, dated October 1, 1915.

TERRITORIAL FORCE RESERVE.

ROYAL ARMY MEDICAL CORPS.

Lieutenant John C. Jefferson, M.B., F.R.C.S., from 3rd East Lancashire Field Ambulance, to be Lieutenant, dated May 7, 1915.

Major Hugh N. A. Taylor, M.D., F.R.C.S., from attached to Units other than Medical Units, to be Major, dated October 8, 1915.

Major John E. W. McFall, M.D., from 1st West Lancashire Field Ambulance, to be Major, dated October 10, 1915.

ROYAL ARMY MEDICAL CORPS FUND.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT THE WAR OFFICE ON WEDNESDAY, OCTOBER 13, 1915, AT 3 P.M., IN ROOM 356.

Present:—

Surgeon-General M. W. Russell in the Chair.
Lieutenant-Colonel W. W. Pope.
Lieutenant-Colonel W. Blackwell.
Major W. A. Ward.

A letter was read from Surgeon-General Sir David Bruce, C.B., apologising for his absence.

(1) The Minutes of the last Meeting were read and confirmed.

(2) The grants made to recipients from the General Relief Fund for the half year ending September 30, were considered and passed.

(3) The grants received from companies for the General Relief Fund during the half year ending September 30 were noted.

(4) Sanction was given for a grant of £100 from the General Relief Fund to the R.A.M.C. Comfort Fund for supplying comforts to our men at the Front and to our Prisoners of War.

(5) It was noted that a cheque for £30 has been received from Lady Saunders and Miss Eastman, being part of the proceeds of a concert organized by them in Zululand; to be earmarked for the wounded Royal Army Medical Corps. A letter of thanks from the Committee was sent to them.

(6) It was noted that the sum of £150 voted at the last Annual General Meeting has been sent to the executors of the late Colonel W. Johnston, towards the expenses of the publication of his book on the "History of the Corps." A letter of thanks has been received from Mrs. Johnston.

(7) A letter was read from the Secretary of the Royal Soldiers' Daughters' Home, asking for the removal of a girl from the School, on the ground that she was not likely to become efficient for domestic service.

(8) A letter was read which had been forwarded by the War Office enclosing an application from the widow of the late Captain W. J. Crofton, R.A.M.C., asking for an increase of her pension. The Secretary was directed to reply that the application does not come within the scope of the Royal Army Medical Corps Fund.

(9) It was noted that a sum of £800 belonging to the Royal Army Medical Corps Fund and a sum of £600 of the General Relief Fund have been invested in the new War Loan. The money was transferred from the deposit account for the purpose.

(10) It was decided to ask Surgeon-General F. J. Jencken if he would consent to become an Auditor to the Fund vice Colonel Julian, C.M.G.

(11) A letter was read from the British Consul at Casablanca, Morocco, forwarding an application from Mr. Alfred Lawrence, late Royal Army Medical Corps, asking for a grant from the General Relief Fund. It was resolved that a negative reply should be sent as Mr. Lawrence could obtain employment, if he so wished, either at Gibraltar or at home.

(12) With reference to Minute 4 of the last Committee Meeting, it was resolved to retain the Bandmaster's services until the end of 1916, and it was further decided that a sum not exceeding £175 be expended on the Band next year.

(13) It was proposed by Lieutenant-Colonel Pope and resolved that a circular letter be sent to retired re-employed officers, who are not subscribers to the Fund, asking them to become subscribers.

LISTS OF RECIPIENTS OF GRANTS FROM THE GENERAL RELIEF FUND FOR THE HALF YEAR ENDING SEPTEMBER 30, 1915.

No.	Name	Age	District	Grant	Total	Remarks
475	Mrs. T. G. A...	—	London	£1	£8	Destitution.
476	Miss H. M.	15	Portsmouth	4	20	Sanctioned by Committee.
477	Mrs. A. T. T...	58	Aldershot	3	5	Ill-health; unable to work.

GRANTS RECEIVED FROM COMPANIES AND UNITS FOR THE GENERAL RELIEF FUND DURING THE SIX MONTHS ENDING SEPTEMBER 30, 1915.

Aldershot	£200	0	0	Malta	£8	5	0
Netley	30	0	0	Training Centre—			
Woolwich	17	10	0	Limerick	5	5	0
Colchester	50	0	0	Sling	10	0	0
Devonport	10	0	0	Llandrindod Wells	10	0	0
Chatham	10	0	0	Serjeants' Mess—			
Belfast	10	0	0	Cairo	5	0	0
Dover	9	5	7	Gibraltar	4	0	0
Cork	3	0	0	Sling	5	0	0
Shorncliffe	4	0	0	No. 43 Field Ambulance	1	14	9
Cosham	5	0	0				
Rochester Row	1	0	0		£403	0	4
Gibraltar	4	0	0				

ROYAL SCHOOL FOR DAUGHTERS OF OFFICERS, BATH.

NOVEMBER ELECTION, 1915.

VOTES and interest until election are requested on behalf of Margaret McCulloch, born September, 1902. Second daughter of the late Lieutenant-Colonel T. McCulloch, M.B., R.A.M.C.

The case is known and recommended by Surgeon-General Sir W. Taylor, K.C.B., M.D., K.H.P.; Surgeon-General Sir W. L. Gubbins, K.C.B., M.V.O., M.B.; Brigadier-General W. Baker Brown, R.E.

Lieutenant-Colonel T. McCulloch served for twenty-eight years in the R.A.M.C., including ten years in India. He was employed at the War Office from 1902 to 1906, and saw active service in the China Campaign, 1900 to 1901.

Mrs. McCulloch is left with three children, two girls aged 17 and 13, and a boy, aged 9, and with only a very small private income to supplement her pension. Her eldest son, Lieutenant R. A. D. McCulloch, The King's Own Royal Lancaster Regiment, was killed at the Front in May, 1915.

STATEMENT OF ACCOUNTS FROM JULY 1, 1914, TO JUNE 30, 1915.

BALANCE SHEET.

LIABILITIES.	£	s.	d.	ASSETS.	£	s.	d.
To Publishers' Bill for June Quarter, 1915	325	1	7	By Cash at Bank	778	3	4
,, ,, March Quarter, 1915	219	3	6	,, Value Stamps in Hand	1	8	8
,, Balance Credit	2,393	1	2	,, Investments at Minimum Price			
				£1,000 India Stock at 80¾ .. £807 10 0			
				£1,500 Consols at 65 .. .. 975 0 0			
				£200 Tasmanian Stock at 94 .. 188 0 0			
				—— ——	1,970	10	0
				,, Furniture, etc., as per last Balance Sheet 21 10 3			
				Written off for depreciation .. 2 3 0			
				—— ——	19	7	3
				,, Outstanding for Subscriptions	53	0	0
				,, Do. Advertisements	115	0	0
	£2,937	9	3		£2,937	9	3

TRADING ACCOUNT.

FROM JULY 1, 1914, TO JUNE 30, 1915.

EXPENDITURE.	£ s. d.
To Publishers' Bills—	
Journal	1,001 9 10
Corps News	198 2 8
Calendars	20 3 6
Reprints	6 9 0
Envelopes, Postage and Packing	51 18 3
Sundries	2 16 8
,, Balance to Profit and Loss Account	318 11 7
	£1,599 11 6

RECEIPTS.	£ s. d.	£ s. d.
By Subscriptions to Journal	1,136 11 8	
,, ,, Outstanding June 30, 1915	53 0 0	
	1,189 11 8	
Deduct Subscriptions credited in error .. £2 1 0		
Deduct Subscriptions outstanding June 30, 1914 .. .. .. 1 0 0		
	3 1 0	
		1,186 10 8
By Subscriptions to Corps News		18 14 3
,, ,, Seniority Rolls		9 4 1
,, ,, Calendars		0 12 3
,, Receipts for Covers and Binding		0 3 0
,, ,, ,, Reprints		0 14 9
,, Advertisements		221 5 0
,, Sales through Manager		0 19 10
,, ,, ,, Publishers		161 7 8
		£1,599 11 6

PROFIT AND LOSS ACCOUNT.

FROM JULY 1, 1914, TO JUNE 30, 1915.

EXPENDITURE.	£ s. d.	£ s. d.
To Business Manager's Account—		
Clerk to Manager	24 0 0	
,, Editor	12 12 0	
Postages	8 19 7	
Stationery	0 19 0	
Postman	1 0 0	
		47 10 7
,, Honorarium to Editor		100 0 0
,, ,, Auditor		2 2 0
,, Exchange on Drafts		0 1 9
,, Refund for Reprints not Supplied		0 14 9
,, Written off for Depreciation of Furniture ..		2 3 0
,, ,, ,, Investments ..		404 17 9
,, Balance carried to Balance Sheet—		
Balance, July 1, 1914	2,558 5 3	
Less Net Loss during the year ..	165 4 1	
		2,393 1 2
		£2,950 11 0

(Signed) H. BARROW, *Lieut.-Colonel, R.A.M.C.*
Hon. Manager, Journal R.A.M.C.

RECEIPTS.	£ s. d.
By Balance from last Account	2,558 5 3
,, Gross Profit on Trading Account	318 11 7
,, Interest on India Stock	32 1 0
,, ,, Consols	34 6 10
,, ,, Tasmanian Stock	7 6 4
	£2,950 11 0

Examined and found correct,
(Signed) EDMOND T. GANN.

September 30, 1915.

DEATHS.

CROKER.—Surgeon Lieutenant-Colonel John Randal Croker, retired Army Medical Staff, died at Herne Bay, on September 29, 1915, aged 75.

CUFFE.—Surgeon-General Sir Charles MacDonogh Cuffe, K.C.B., F.R.C.S.Edin., retired, Army Medical Staff, died at 2, Cadogan Gardens, London, S.W., on October 4, 1915, aged 73.

GRAY.—Surgeon-Major Charles Gray, retired, Medical Department, died at 13, Elvaston Place, South Kensington, on September 25, 1915, aged 81.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

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25	4	0 3 0	0 1 3	4	0	1	3	3	6	0	9
	8	0 5 6	0 2 6								
	16	0 9 6	0 4 6								
50	4	0 4 0	0 1 8	5	0	1	9	4	0	1	0
	8	0 6 9	0 3 2								
	16	0 12 0	0 5 3								
100	4	0 5 6	0 2 9	6	6	3	3	5	6	2	0
	8	0 9 0	0 4 4								
	16	0 16 9	0 6 9								
200	4	0 8 6	0 4 0	9	0	6	3	7	6	4	0
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Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notifies at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, London, S.W.

Communications have been received from Surgeon-General W. G. Macpherson, Professor S. Delépine, Temporary Lieutenant-Colonel R. T. Leiper, Major G. H. Brown, Captain A. Abrahams, Captain R. L. Scott.

The following publications have been received:—

British: The Sanitary Record and Municipal Engineering, Red Cross and Ambulance News, The Hospital, The Medical Journal of South Africa, The Lancet, The Medical Journal of Australia, The Journal of Tropical Medicine and Hygiene, The Medical Press and Circular, The Medical Review, Tropical Veterinary Bulletin, Proceedings of the Royal Society of Medicine, The Middlesex Hospital Journal, Public Health, The British Journal of Tuberculosis.

Foreign: Bulletin de l'Institut Pasteur, Annali di Medicina Navale e Coloniale, United States Public Health Service, Revista de Sanidad Militar, Office International d'Hygiène Publique, Proceedings of the Medical Association of the Isthmian Canal Zone.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

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